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Errata

Page 31, line 5, for *occidentalis*, read *occidentale*.

Page 112, line 3 from bottom, *for* identity, *read* identify.

Page 114, line 13 from bottom (second column), *after* MAGNOLIA GRANDIFLORA, *add* (H).

Page 114, line 10 from bottom (first column), *after* Morus rubra *add* (h).

Page 115, line 14 from bottom (second column), for Cardiospermum Halicacabum, read *Cardiospermum Halicacabum*.

Page 122, line 2 from bottom, *for* Buff, *read* Bluff.

Page 196, line 20, for *Geinitzii*, read *Geinitzi*.

Page 199, line 14, for *Heeri*, read *Heerii*.

Page 220, line 9 from bottom, for *Donnelli*, read *Donnellii*.

Page 251, line 10, *for* was, *read* were.

Page 385, line 4 from bottom, *for* Not all species, *read* None of the specimens.

Page 385, line 3 from bottom, *for* belong, *read* belongs, and *for* for, *read* although.

Page 447, lines 10 and 11 from bottom, for *Macounii*, read *Macounii*.

Page 556, line 4 from bottom, for *Flodmannii*, read *Flodmanii*.

Page 557, line 16, for *brevifolius*, read *brevifolium*.

Page 559, line 2 from bottom, *for* Schuykill, *read* Schuylkill.

Vol. 37 No 1

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A manual of the genus Usnea, as represented in North and Middle America, north of the 15th parallel

R. HEBER HOWE, JR.

(WITH PLATES 1–7)

In my " Preliminary review of the genus *Usnea* " (Bull. Torrey Club **36** : 309–327. *pl. 21–23*. 1909), based on a long field and laboratory study of the plants as represented particularly in New England, I made no attempt to cast aside the nomenclature adopted by Tuckerman, the recognized authority for American workers. I intimated then, however, that a broader study of the genus, with the application of the present rules of nomenclature, would lead no doubt to a better understanding and hence to a more lucid taxonomy. I have now reached a point where the continuous use of a carefully determined classification finds no inadequacies, and I therefore see no reason to withhold its publication for a longer period of time, as I believe it soundly based and likely therefore to meet with general adoption, at least by the broader and more conservative workers. It is in no way new, but rather very old.

A revision of the genus becomes necessary for three reasons : first, the current use of a nomenclature that is illegitimate according to the accepted rules ; secondly, the unwarranted use of the specific term *barbata*, fulfilling at least a sectional, if not almost a generic conception ; and, lastly, the hopeless misunderstanding of species and subspecies, evidenced by the extensive synonymy. Linnaeus' species *Lichen plicatus*, *L. barbatus*, *L. hirtus*, and *L.*

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floridus, here named in order of pagination * priority, all seem to intergrade and belong to one species ; with a broader conception, however, true transitional examples are in reality rare, if in some cases occurring at all.

The difficulty has been that too many purely contingent varieties have been described and recognized, so that the Linnaean conception and nomenclature has been embarrassed ; whereas, for the papillate species (all he considered), it was exceedingly near the proper elucidation. Each of the following species represents a variable, but a distinct, plant, found both fruited and sterile. Though true intergrades may appear occasionally, they are not important enough to make it necessary for us to blind our understanding by adopting a special nomenclature to explain their presence ; if we should do this and should follow the present rules of nomenclature, we must cast aside appropriate names, applicable original descriptions, and good recognizable figures, and the general procedure of nearly two hundred years, and use the names simply as handles with no other significant connection whatever. This, it is plain, would be distinctly undesirable.

That there must come a reaction from the naming of contingent phases in lichenology is evident. There is no halting if once it is begun, and the inevitable result is, names standing for unique individuals, and type localities reduced to certain fallen logs or crumbling ledges. The law of variability is being sadly overlooked. A study of the limits of variation in species will throw hundreds of names already given into a now tangled synonymy.

Two distinct types of subspecies have been recognized, only one of which has a proper claim to recognition. The first type is what I have termed in my former paper "contingent phases,' states of development brought about by very local and temporary conditions ; as a result of separations thus based we have in our synonymy such subspecies and forms as *hirta*, *rubiginea*, etc. The second type of subspecies, based on the results of actual morphological differentiation, due to the fixed but varied environmental effects of wide geographical distribution or of altitude, are, it is needless to say, scientifically grounded and worthy of recognition, if the separations of this nature are well defined and not of

* Unrecognized by the Vienna Rules.

trivial and opinionable character. Of this type we have, curiously enough, in our area no named examples in this genus. Others based on mere morphological reduction, a condition seen in *U. plicata*, *U. longissima*, and *U. angulata*, as represented by comparing specimens from the southern and northern limits of their range, hardly need titles of separation, nor do the abnormally developed examples growing in regions under particularly acceptable conditions. *Usnea strigosa* (Ach.) and *U. californica* Herre represent this class.

Usnea * (Dill.) Adans. Fam. Pl. **2**: 7. 1763

Description: *Apothecia* lateral, subterminal or terminal, peltate, applanate, coriaceous, emarginate, periphery generally ciliate; thalline exciple glabrous, lacunose, echinate or ciliate, concolorous, pale stramineous or virescent, sometimes pruinose (rarely dichroic-red). *Asci* clavate, containing 8 spores; *paraphyses* gelatinous, filamentous. *Spores* monoblast, hyaline, ellipsoid. *Spermogones* lateral, immersed in shallow, colorless conceptacles. *Sterigmata* simple or subsimple. *Spermatia* fusiform or acicular-cylindrical, incrassate, apices truncate. *Soredia* normal, occasional on all forms. *Cephalodia* lateral, concolorous or darker, sometimes black. *Thallus* erect, subpendulous, or pendulous, branched, fibrillose or efibrillose, terete, compressed or angulate, nitidous, glabrous, scabrous, squamose, or foveolate, papillate or epapillate, pale stramineous, virescent, green, or tawny; cortex subcrustose, subcontiguous, bambusaceous, or articulate; gonidia "*Protococcus*"; † medulla cottonous, central indurated chondroid cord percurrent.‡

Thallus papillate

Usnea florida (L.) Web.

Type: Species based on *Usnea vulgatissima* of Dillenius; the Dillenian specimens "typical and fertile" are in the Dillenian herbarium, Botanic Gardens, Oxford, England, and are "*Usnea florida* (L.)" *fide* Crombie.§

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* From the Arabic - - usnah.

† "*Cystococcus humicola*" according to A. Schneider, Text-Book Lich. 99. 1897.

‡ For microscopic anatomy see Schwendener in Naegeli, Beitr. Wiss Bot. **2**: 110-144. *pl. 1, 2.* 1860. Nylander, Synop. Lich. *pl. 8. f. 7-11.* 1858-60; and Schulte, Beih. Bot. Centralb. $\mathbf{18}^{2}$: 1-22. 1904.

§ Jour. Linn. Soc. **17**: 554-556. 1880.

TYPE LOCALITY: "Europae."

ORIGINAL DESCRIPTION: "Filamentosus ramosus erectus, scutellis radiatis," L. Sp. Pl. 1156. 1753.

FIGURES: [Micheli, Nov. Pl. Gen. *pl. 39. f. 5e.* 1739.]* [Dill. Hist. Musc. *pl. 13. f. 12, a, b, c, d; f. 13, a, b, c, d.* 1741.] Willd. Röm. & Ust. Mag. Bot. **2**[4]: *pl. 1. f. 3.* 1788. Hoffm. Descript. et Adum. Pl. Lich. **2**: *pl. 30. f. 1, 2.* 1794. Ach. Kongl. Vet.-Acad. Nya Handl. **16**: *pl. 8. f. 1.* 1795. Schrad. Jour. Bot. **1**: *pl. 3. f. 1, 2.* 1799. Sowerby, Eng. Bot. **13**: *pl. 872.* 1801; **19**: *pl. 1354.* 1804. Ach. Meth. Lich. *pl. 6. f. 3.* 1803. Sprengel, Anleit. **3**: *pl. 10. f. 105.* 1804. Fée, Essai sur les Crypt. *pl. 3. f. 4, 5; pl. 32. f. 5.* 1824.

SYNONYMY: [*Usnea vulgatissima, etc.* Dill. *loc. cit.* 67.]

Lichen floridus L. *loc. cit.* 1156.

Usnea florida Web.; Wigg. Prim. Fl. Holsat. 91. 1780.

DIAGNOSIS: *Thallus erect*, cespitose.

DESCRIPTION — typical: *Thallus* erect, cespitose, rigid, terete, virescent; cortex soon scabrous, and annularly scarred; *primary branches* coarse, *divaricate* (max. length 12 cm.); *secondary branches* subpedicellate, subdichotomous; *fibrils* short (6 mm.), *subequiform*, frequent or stipate, rectangularly divergent, rarely dichotomous. *Apothecia common*, terminal, ample, sometimes lacerate; disk pruinose, flesh-colored or buff, rarely virescent; periphery and thalline exciple ciliate. Spores 4–8 $\mu \times$ 3–6 μ.

CONTINGENT PHASES: (*a*) With age blackening, crustose, brittle, leprous, abraded, nodular-bambusaceous, articulate, white medulla exposed, indurated cord visible.

(*b*) Branches sorediate, soredia often becoming confluent near the apices (*Lichen hirtus* L. *loc. cit.* 1155).

(*c*) Dichroic (red, either affecting all or part of the plant) (*Usnea florida*, var. *rubiginea* Michx. Fl. Bor.-Am. **2**: 332. 1803).

(*d*) Strigose, apothecia very ample, disk now virescent (*Usnea florida*, *γ strigosa* Ach. Meth. Lich. **2**: 310. 1803). This phase is most common in Mexican and Arizona plants.

(*e*) Apothecia small, cyathiform.

(*f*) Reduced, very cespitose, branches hispid and echinate.

(*g*) Branches somewhat naked, furcate, and apices attenuate.

(*h*) Nitidous or granulate, internodes somewhat inflated, apices

* Pre-Linnaean references are enclosed in brackets.

of fibrils recurved and sorediate (*Usnea barbata florida* f. *sorediifera* Arn. Flora **57**: 569. 1874).

Substrata: Living deciduous and coniferous trees, specimens generally degenerate on other substrata.

Geographical distribution: Common throughout North America, represented in all zones, and reaching its greatest development and luxuriance in the mountains of Mexico (8000 ft.), and becoming rare and poorly exhibited in the upper Boreal zone. It is not reported from Labrador, but it is generally recorded from Alaska, whence I have seen normal and well-fruited specimens.

Observations: This plant, *Usnea barbata*, a *florida* Fr. of Tuckerman, is the most cosmopolitan species of the genus; both its sterile and fertile forms, however, show enormous variation. It is nevertheless the typical species of the papillate group and makes the most natural starting point for the taxonomy and an understanding of the genus. ("Typus speciei est forma *florida*," Fr. Lich. Europ. 19. 1831.)

Usnea plicata (L.) Web.

Type: Species based on *Usnea vulgaris* of Dillenius; the "fertile" Dillenian specimen "sufficiently characteristic, though . . . broken up into three portions," is in the Dillenian herbarium, Botanic Gardens, Oxford, England, and is "*Usnea ceratina* Ach." *fide* Crombie.

Type locality: "Europae & Americae borealis." ("Habeo eandem ex Virginia a Jo. Mitchellio et ex Pensylvania a Jo. Bartramo transmissam." — Dill.)

Original description: "Filamentosus pendulus, ramis implexis, scutellis radiatis," L. Sp. Pl. 1154. 1753.

Figures: [Dill. Hist. Musc. *pl. 11. f. 1.* 1741.] Sowerby, Eng. Bot. **4**: *pl. 2.* 1795. Ach. Nova Acta Soc. Sci. Upsal. **7**: *pl. 7. f. 2.* 1815. Schaer. Enum. Crit. Lich. Europ. *pl. 1. f. 1.* 1850. A. Schneider, Guide Study Lich. *pl. 4.* 1904.

Synonymy: [*Usnea vulgaris, etc.* Dill. *loc. cit.* 56.]

Lichen plicatus L. Sp. Pl. 1154. 1753.

Usnea plicata Web.; Wigg. Prim. Fl. Holsat. 91. 1780.

Diagnosis: *Thallus pendulous, plicate,* strongly papillate; short rectangularly divergent *fibrils sparse* or *wanting*.

Description — typical: *Thallus pendulous, coarse*, pliant, terete (rarely angularly deformed), cortex at length proximally scabrous, annularly scarred, stramineous to virescent; *primary branches* coarse, at length intricately plicate, subpatent (max. length 130 cm.); *secondary branches* much divided, subdichotomous; *fibrils* polymorphous, tortuous, sparse or wanting, simple or commonly subdichotomous. *Apothecia* not uncommon, lateral and sessile, or subterminal, ample (1 cm.), now lacerate, disk flesh-colored or buff, periphery naked or ciliate. Spores as in *U. florida.*

Contingent phases: (*a*) As in *U. florida.*

(*b*) Branches sorediate (*Usnea ceratina, β scabrosa* Ach. Lich. Univ. 620. 1810).

(*c*) Dichroic (red). This condition is rare, and never so far as observed affecting all parts of a plant (*Usnea ceratina*, var. *β scabrosa*, form *ferruginascens* Crombie, Trans. Essex Field Club **4**: 60. 1885).

(*d*) Naked of fibrils, the latter rarely present as a minute hispid clothing (Plate 3, figure 2).

Substrata: Deciduous and coniferous trees, occasionally on dead wood.

Geographical distribution: Common in the Austral and Transition zones, occurring also in a reduced, sterile, but perfectly characteristic state in the Boreal zone, reaching its most dwarf condition in Alaska (and Siberia).* It is best exhibited on the Pacific coast (Marin and San Mateo counties, California), where the plants are stramineous, and very pendulous (130 cm.), reaching possibly its highest development in Alpine Creek Cañon (1000 ft.), San Mateo Co., California, in the species (?) *Usnea californica* Herre, and in Mexico. Atlantic and Gulf coast specimens are less pendulous (30 cm.), generally virescent, and occasionally destitute of fibrils (see Bull. Torrey Club **36**: *pl. 21*).

Observations: I have included under this species all forms heretofore separated under *ceratina.* The slight variation of *Usnea plicata* that answers to Schaerer's *U. ceratina* does not occur in North America so far as I have observed, nor is the form constant or desirable of recognition in the Old World according to the material I have examined, some of which was determined by Schaerer himself.

* This is *U. barbata*, d *plicata* Fr. of Tuckerman and most modern authors.

Usnea plicata barbata (L.) R. H. Howe, comb. nov.

TYPE: Species based on *Usnea barbata* of Dillenius; the "sterile" Dillenian specimen is in the Dillenian herbarium, Botanic Gardens, Oxford, England, and has been determined by Crombie as "*Usnea dasypoga* (Ach.)."

TYPE LOCALITY: "Europae & Americae septentrionalis." ("Eandem habeo ex Pensylvania."— Dill.)

ORIGINAL DESCRIPTION: "Filamentosus pendulus subarticulatus, ramis patentibus," L. Sp. Pl. 1155. 1753.

FIGURES: [Dill. Hist. Musc. *pl. 12. f. 6.* 1741.]

SYNONYMY: [*Usnea barbata, etc.* Dill. *loc. cit.* 63.]

Lichen barbatus L. Sp. Pl. 1155. 1753.

Usnea barbata Web.; Wigg. Prim. Fl. Holsat. 91. 1780.

DIAGNOSIS: Similar to *U. plicata* but *less coarse*, secondary branches *closely* beset with *equiform rectangularly divergent fibrils.*

DESCRIPTION—typical: *Thallus* pendulous, less coarse than in *U. plicata*, terete, scabrous, annularly scarred, stramineous to virescent, papillae now sparse, often confined to proximal portions of primary branches (now ruptured-sorediate); *primary branches* proximally coarse, rarely at length intricate, subpatent (max. length 120 cm.); *secondary branches* simple, occasionally dichotomous; *fibrils* equiform (2–8 mm.), subflexuous, stipate, simple, rarely dichotomous, rectangularly divergent. *Apothecia* as in *U. plicata*, but smaller (6 mm.) and very infrequent. Spores as in *U. florida*.

CONTINGENT PHASES: (*a, b, c*) As of *U. plicata*.

(*d*) Primary branches darkening.

SUBSTRATA: As in *U. plicata*.

GEOGRAPHICAL DISTRIBUTION: Common throughout the upper Austral and Transition zones, occurring also in the lower Boreal. Like the last, it is better exhibited on the Pacific coast, where the plants are stramineous, intricate and very pendulous (130 cm.). On the North Atlantic coast it is virescent, and rarely obtains a pendular length of over 35 cm. Here also it is less intricate, generally consisting of six or eight simple branches arising from a single base.

OBSERVATIONS: This plant, *Usnea barbata*, c *dasypoga* Fr. of Tuckerman, is similar to *U. plicata*, but it is never so coarse, its secondary branches are simple or subsimple and have rectangu-

larly divergent equiform fibrils. These secondary branches taken alone strongly suggest *U. longissima*, but are generally somewhat papillate or papillo-sorediate, and not covered with a white farinaceous soredial crust. Dillenius' figure shows a characteristic intermediary condition, some of the secondary branches suggesting the species *U. plicata*, while the majority are nearly typical of the present subspecies. This intermediary state is not uncommon, a specimen from Newfoundland (Waghorne, 1890, called *U. longissima*) in the herbarium of the Academy of Natural Sciences, Philadelphia, almost exactly duplicates the subject of Dillenius' figure, showing the unusual dichotomously branched fibrils.

Thallus epapillate

Usnea trichodea Ach.

Type: Not indicated, but the specimen on which the species was based is in the Acharian herbarium, Universitetets Botaniska Institution, Helsingfors, *fide* Prof. Dr. Fred. Elfring, *in litt.*, Apr. 7, 1909.

Type locality: " Nova Scotia " [" *Menzies*," *fide* Elfring].

Original description: " Thallo subcrustaceo filamentoso tenerrimo tereti diffuso albo-pallescente, lorulis capillaceis ramosis fibrillis subsecundis ; orbillis concoloribus margine tenui inflexo nudo integro," Ach. Meth. Lich. **2**: 312. 1803.

Figure: Ach. *loc. cit. pl. 8. f. 1.*

Synonymy: *Usnea trichodea* Ach. *loc. cit.* **2**: 312. 1803.

Diagnosis: *Thallus pendulous*, glabrous, fibrils *capillaceous.*

Description — typical: *Thallus* pendulous, slender, mollitinous, terete, virescent, cortex *glabrous* or *nitidous*, annularly scarred, at length bambusaceous; *primary branches* slender, at length proximally scabrous, much divided (max. length 25 cm.); *secondary branches* subdichotomous, much divided; *fibrils capillaceous*, tortuous. *Apothecia* common, marginate, at length lacerate, lateral, sessile, small (diameter 4 mm.), disk flesh-colored or buff, margins naked or sparsely ciliate. *Spores* 4–8 $\mu \times$ 3–6 μ.

Contingent phases: (*a*) As in *U. plicata*.

(*b*) Cortex now locally ruptured by soredia.

Substrata: Coniferous trees, frequently on dead wood, and occasionally on accompanying deciduous trees.

Geographical distribution: Abundant throughout the Tropical, Austral, Transition, and Canadian zones on the Atlantic coast, occurring from Newfoundland (*Waghorne*) to Cuba (*Wright*), extending westward as far as Iowa, Wisconsin, and Minnesota (*Fink*), and south to Tennessee, Missouri, Alabama, Louisiana, and Texas, *U. cavernosa* seeming to replace it from here westward, though (in a peculiar condition) it was recorded from the Yellowstone region in 1872 by Willey.

The type or topotypes of the variety from Texas described by Müller I have not seen; the following original description is, however, applicable to a plant sent me by Professor Macoun from Vancouver Island, at the entrance to Barclay Sound, collected in 1909. A microscopic study of this plant shows it, nevertheless, to be closely affiliated to *U. longissima*, if not simply a young or abnormal specimen of the latter species. "*Usnea trichodea* var. *ciliata* Müll.-Arg." was described as follows: "thallus more *U. trichodeae* tenuis, laevis et albido-cinereus, at longe aut longissime ramigerus et more *U. longissimae* dense fibrillosus; apothecia parva, 1.5–3 mm. lata, raro diametro 6 mm. attingentia, ambitu ciliis 3–8 circ. 2–5 mm. longis ornata, dorso subinde pauci-fibrilligera et elongatione ramilli deflexi saepius praedita, discus glauco-albidus v. albo-carneus; sporae ellipsoideae v. subgloboso-ellipsoideae, 5–8 μ longae. — Habitat ad ramos et ramulos arborum prope Dallas, Texas."

Usnea articulata (L.) Hoffm.

Type: Species based on *Usnea capillacea* and *U. nodosa* of Dillenius; the "sterile" Dillenian specimen is in the Dillenian herbarium, Botanic Gardens, Oxford, England, and is the species commonly understood as "*Usnea articulata* (L.)" *fide* Crombie.

Type locality: "Europae australis."

Original description: "Filamentosus articulatus, ramulis tenuissimis punctatis," L. Sp. Pl. 1156. 1753.

Figures: [Dill. Hist. Musc. *pl. 11. f. 4.* 1741.] Sowerby, Eng. Bot. **4**: *pl. 258* (?). 1801.

Synonymy: [*Usnea capillacea et nodosa*, etc. Dill. *loc cit.* 60.]

Lichen articulatus L. Sp. Pl. 1156. 1753.

Usnea articulata Hoffm. Deutsch. Fl. **2**: 133. 1795.

Diagnosis: *Thallus* pendulous, *primary branches* articulate and inflated.

Description — typical: *Thallus* pendulous, catenate, terete or compressed, virescent to tawny, cortex nitidous or glabrous (secondary branches and fibrils now papillo-servediate); *primary branches* deformed, *articulate*, *internodes inflated* (max. diameter 5 mm.), foveolate, dichotomous, glabrous (max. length 30 cm.); *secondary branches* subdichotomous, much divided, scabrous; *fibrils capillaceous*, tortuous. *Apothecia* rare, subterminal, small (max diameter 5 mm.), disk pruinose, flesh-colored or buff, periphery ciliate. *Spores* 8–10 μ × 5–6 μ.

Contingent phases: Unobserved.

Substrata: Trees, for the most part deciduous.

Geographical distribution: Reported by Tuckerman as "ill-exhibited in North America; but it is not wholly wanting on the Pacific Coast; *Scouler; Macoun*." Professor Macoun reports it (Cat. Can. Pl. **7**: 61. 1902) from [Hastings] Burrard Inlet, British Columbia, Canada (1889),* and also from Victoria, Vancouver, British Columbia, Canada (1875). The Victoria record is the one to which Tuckerman referred; the specimen is now in the Museum at Kew, England (*fide* Macoun). Professor Bruce Fink in "Contributions to the Lichens of Minnesota — VII" (Minnesota Bot. Stud. **3**: 194. 1903) records three specimens (*nos. 143, 711, 1636*, herb. Univ. Minn.) collected respectively at Beaudette, Emo, and Harding in 1901. These specimens, which Professor Fink writes me he was already aware were wrongly determined, have been kindly sent me by Dr. C. O. Rosendahl of the University of Minnesota and prove to be typical *Usnea cavernosa* Tuck.

Professor Macoun has sent me a sterile specimen, collected Aug. 16, 1909, at Ucluelet Arm, north of Barclay Sound, British Columbia, which, though no doubt closely approaching this species and to be referred only here, is, nevertheless, decidedly atypical. It is only slightly inflated, decidedly papillate, not foveolate, and has non-capillaceous fibrils. It certainly ill exhibits true *Usnea articulata*.

The inclusion of this species as a North American plant is only empirical.

* This specimen (no. 10), kindly sent me by Professor Macoun, is *Alectoria ochroleuca sarmentosa* Nyl.

Observations: This species is certainly closely allied to *U. cavernosa.* Except for articulate inflated thallus, it is in every way similar. None of the specimens I have examined have been truly papillate. That it is an accidental monstrosity was the opinion of Fries and later writers. If not a "monstrositas" its morphological differentiation certainly deserves for it full specific rank. The scarcity of plants of this species in herbaria points to its rarity and limits its study. Only a field investigation of growing plants can solve its true identity.

The variety *dimorpha* of Müller from Cuba I have been unable to see. The following original description must uphold its own case: "*Usnea articulata* Hoffm. v. *dimorpha* Müll. Arg.; straminea, rami tenues et laevissimi, parce articulati, ramillis modice numerosis aliis capillaribus elongatis laevibus aut minute nodulosis et simul aliis intermixtis confertim divaricato-ramosissimis et crebre tuberculosis quasi nodulosis praediti; apothecia parvula, straminea, crebre ciliata, cilia breviuscula, simplicia et rudimentarie divaricato-ramulosa et partim nodulosa. — Habitu ad *U. dasypogoidis* v. *exasperatum* Müll. Arg. accedit, sed rami minus dense ramilligeri, tenuiores et distincte articulati, parce impressuli, ramilli demum dimorphi. — Cuba, ramulicola in Pinal de Sta. Ana, alt. 2400 ped.: Eggers Flor. Ind. Occ. exs. n. 5015." Disposition of type not indicated.

Usnea cavernosa Tuck.

Type: In the Tuckerman herbarium, Botanic Museum, Harvard University, Cambridge, Mass.

Type locality: "Ad arbores in oris Lacus Superioris."

Original description: "Thallo pendulo laxo molli glaberrimo tereti compresso plus minus cavernoso ochroleuco, ramis primoribus simpliciusculis subventricosis attenuatis ad apices dichotome ramosis, ramulis ultimis tenuissime capillaceis; apotheciis sessilibus radiatis disco albido-pruinoso demum subcarneo margine obscuriori evanescente." Agassiz & Cabot, Lake Superior, etc. 71. 1850

Figures: None.

Synonymy: *Usnea cavernosa* Tuck. Agassiz & Cabot, *loc. cit.* 71. 1850.

Diagnosis: *Thallus* pendulous, terete or subterete, *foveolate fibrils capillaceous.*

DESCRIPTION — typical: *Thallus* pendulous, slender, *mollitinous*, terete or subterete, virescent, cortex glabrous or granulose, annularly scarred, at length bambusaceous; *primary branches* slender, at length proximally scabrous, *foveolate* (max. length 35 cm.); *secondary branches* dichotomous, much divided, *foveolate*; *fibrils capillaceous*, tortuous. *Apothecia* common, emarginate or submarginate, at length lacerate, lateral, sessile, *small* (diameter 4 mm.), disk flesh-colored or buff, periphery ciliate. *Spores* 5–10 $\mu \times$ 4–7 μ.

CONTINGENT PHASES: Unobserved.

SUBSTRATA: Coniferous and deciduous trees.

GEOGRAPHICAL DISTRIBUTION: Common in a broad sense throughout the Transition zone. I have a typical specimen from Brunswick, Maine. It is reported from the White Mountains by Tuckerman, and I have seen two specimens from Plymouth, N. H. It is common in Minnesota about Lake Superior, and I have examined material from Colorado, Washington (Puget Sound, *Fink*), Arizona, and Mexico (Jalaspasco, 10,000–12,000 ft.); Nylander records it from Michigan; Leighton from Great Slave Lake, Canada, well within the Boreal zone.

USNEA ANGULATA Ach.

TYPE: Not indicated, but the specimen on which the species was based is in the Acharian herbarium, Universitetets Botaniska Institution, Helsingfors, *fide* Prof. Dr. Fred. Elfring, *in litt.*

TYPE LOCALITY: "Americae Septentrionalis" (Pennsylvania—*Muhlenberg*).

ORIGINAL DESCRIPTION: "Thallo pendulo flexuoso subsimplici angulato cinereo-pallido, angulis acutis scabris, fibrillis horizontalibus approximatis simplicibus brevibus tereti-attenuatis," Ach. Synop. Meth. Lich. 307. 1814.

FIGURE: Harris, Bryologist 4: *pl. 1. f.* —; *pl. 2. f. c.* 1901.

SYNONYMY: *Usnea angulata* Ach. *loc. cit.* 307. 1814.

DIAGNOSIS: *Thallus* pendulous, subsimple, *angulate.*

DESCRIPTION — typical: *Thallus* pendulous, simple, rigid, coarse, *angulate*, stramineous to virescent (at length fuscous), cortex scabrous, now squamose; *primary branches* simple, *angulate* (now compressed particularly in the axils), coarse, dichotomous (max. length 3 m.); *secondary branches* rare (common in tropical examples), *angulate*, dichotomous; *fibrils* terete (or deformed),

equiform (2–8 mm. long.), *attenuate*, stipate, *rectangularly divergent*, sometimes dichotomous and spiculose. *Apothecia* sessile, lateral, terminal or subterminal on secondary branches, ample (max. diameter 1.5 cm.), thalline exciple smooth or reticulate, periphery and exciple ciliate. *Spores* 5–9 μ × 4–6 μ.

CONTINGENT PHASES: Unobserved, except of reduction.

SUBSTRATA: Coniferous and deciduous trees.

GEOGRAPHICAL DISTRIBUTION: This plant is best exhibited in South America, and in our area in Mexico. Throughout the United States it is practically confined to the Austral zone, not having been collected north of about the 43d parallel of latitude, nor west of Minnesota, Iowa, Louisiana, and Texas, or roughly the 97th meridian, except in Mexico.

OBSERVATIONS: The typical fertile plant (Bolivia, Ecuador, Brazil, and Somaliland) is the most gross and coarse representative of the genus. It has been obtained in fruit only in the southern limits of the area under consideration, occurring in a most reduced state, except in Mexico and the West Indies. In color it is virescent, soon turning to brown.

USNEA LONGISSIMA Ach.

TYPE: Not indicated, but the specimen on which the species was based is in the Acharian herbarium, Universitetets Botaniska Institution, Helsingfors, *fide* Prof. Dr. Fred. Elfring *in litt.*

TYPE LOCALITY: "Lusatiae."

ORIGINAL DESCRIPTION: "Thallo pendulo filiformi scabro compresso albissimo simpliciusculo longissimo fibrilloso, fibrillis horizontalibus approximatis tortuosis simplicibus cinerascentibus," Ach. Lich. Univ. 626. 1810.

FIGURES: Ach. Nova Acta Soc. Sci. Upsal. **7**: *pl. 7. f. 5.* 1815 [not 1795 as often cited]. Harris, Bryologist **4**: *pl. 1.* 1901.

SYNONYMY: *Usnea longissima* Ach. Lich. Univ. 626. 1810.

DIAGNOSIS: *Thallus* pendulous, *simple*, primary branches covered with a *white furfuraceous crust* (soredia).

DESCRIPTION—typical: *Thallus* pendulous, *simple*, mollitinous, subterete or compressed, stramineous to virescent, primary cortex *albo-furfuraceous* (soredia), fibrils glabrous; *primary branches* simple, slender (max. length 3 m.), *white*-sorediate; *secondary*

branches rare or wanting; *fibrils* equiform (5 mm. to 2 cm. long), stipate, *rectangularly divergent*, rarely dichotomous. *Apothecia* (so far practically unknown in North American specimens) seen only in Bavarian examples, terminal on lateral fibrils, very small (max. diameter 3 mm.) subcyathiform, disk concolorous or buff, periphery ciliate. *Spores* 7–10 $\mu \times$ 4–6 μ.

CONTINGENT PHASES: (*a*) Fibrils more or less sorediate.

SUBSTRATA: Coniferous and deciduous trees, occasionally dead wood.

GEOGRAPHICAL DISTRIBUTION: Common throughout the Boreal zone, reaching its highest development, like all the Usneas, on the Pacific coast.

OBSERVATIONS: This plant is much reduced throughout our area, and has never been reported in fruit, except from the Santa Cruz peninsula, California (*Herre*), where it is still inferior in development as compared with specimens from Bavaria. In the northernmost limit of its range, and in the east, it is distinctly virescent, whereas in the west and southwest it is stramineous. This characteristic color condition is true of all the filamentose Usneas in our area.

The scarcity of North American material of the typically antarctic lichen *Usnea sulphurea* (Zoega) Th. Fr., reported only twice from the Arctic regions of North America (Melville Island, R. Brown, Babington; and Greenland; *J. Vahl*), makes it impossible to give to it the necessary study; I am inclined, however, to agree with Nylander's view, and place this *dark*-disked, at length interruptedly corded species in the genus *Neuropogon* of Nees and Flotow,* where it seems more naturally to belong, — set apart from the *pale*-disked, *percurrently* corded species here included under *Usnea*. The question of the ciliated apothecia, an unstable character, is not important. The spores here average distinctly larger. The species belongs to the papillate division. The genus *Eumitria* † of Stirton does not concern us in connection with our area.

SYNONYMY

The following list of titles is an attempt to give the original citations and type localities for all the described species of the

* Linnaea, 9: 496. 1835.

† Scot. Nat. 4: 100. 1881.

genus *Usnea* from North and Middle America, and is as complete as a thorough investigation of the literature can make it, though no doubt it has been impossible to trace all descriptions. The citations have all been verified, and checked twice. No attempt has been made to include all the various published combinations, which have varied from binomials even to quinquenomials (Schaerer).

Usnea angulata Ach. Synop. Meth. Lich. 307. 1814: "Americae Septentrionalis."

Lichen barbatus L. Sp. Pl. 1155. 1753: "Europae & Americae septentrionalis."

Usnea californica Herre, Proc. Wash. Acad. Sci. **7**: 345. 1906: "Alpine Creek Cañon, San Mateo County, California"; = *U. plicata* (L.) Web.

U. cavernosa Tuck. in Agassiz & Cabot, Lake Superior 171. 1850: "*Lacus Superioris.*"

U. trichodea var. *ciliata*, Müll.-Arg. Flora **60**: 77. 1877: "Dallas, Texas."

U. cornuta Flot. Linnaea **17**: 16. 1843: "In montibus simensibus" (Abyssinia); reported from British America by Stirton.

U. articulata var. *dimorpha* Müll.-Arg. Flora **74**: 372. 1891: "Cuba."

U. endochrysea Stirt. Scot. Nat. **6**: 107. 1881: "Alabama"; = *U. florida* (L.) Web.

U. filaris Ach. Synop. Meth. Lich. 307. 1814: "America."

U. filipendula Stirt. Scot. Nat. **6**: 104. 1881: "America bor."; = *U. plicata barbata* (L.) R. H. Howe.

U. florida var. *intermedia* Michx. Fl. Bor.-Am. **2**: 332. 1803: "Carolina."

U. jamaicensis Ach. Lich. Univ. 619. 1810: "Jamaicae."

U. lacunosa (Willd. ex Delise MS.) Nyl. Synop. Lich. 271. 1858-60: "America boreali, Michigan"; = *U. cavernosa* Tuck.

U. linearis A. Schneider, Guide Study Lich. 167. 1898; (?) = *U. plicata* (L.) Web.

U. florida var. *major* Michx. Fl. Bor.-Am. **2**: 332. 1803: "Carolina."

U. mutabilis Stirt. Scot. Nat. **6**: 107. 1881: "Alabama"; = *U. florida* (L.) Web.

Lichen plicatus L. Sp. Pl. 1154. 1753: "Europae & Americae borealis."

Usnea florida var. *rubiginea* Michx. Fl. Bor.-Am. **2**: 332. 1803: "Canada."

U. scoparia Fée, Dict. Class. d'Hist. Nat. **16**: 482. 1830: "l'Amérique du Nord."

U. sphacelata R. Brown, Parry's 1st Voy. app. 307. 1824: "Melville Island"; = *Lichen sulphureus* Zoega, in Olafsen & Povelsen, Rejse ig. Island, Tilhang 16. 1772.

U. florida, *γ strigosa* Ach. Meth. Lich. **2**: 310. 1803: "America septentrionali."

U. subfusca Stirt. Scot. Nat. **6**: 108. 1881: "Owen Sound," Ontario; = *U. florida* (L.) Web.

U. trichodea Ach. Meth. Lich. **2**: 312. 1803: "Nova Scotia."

U. variegata Stirt. Scot. Nat. **6**: 105. 1881: "Niagara Falls" = *U. florida* (L.) Web.

To all those persons enumerated in my former paper, to Messrs. A. C. Herre of California, F. G. Blake of Brookline, Mass., Drs. H. E. Hasse of Sawtelle, Cal., Fred. Elfring of Helsingfors, A. Schneider of California, Prof. John Macoun of Ottawa, and to many others I owe much gratitude, as well as to Dr. C. Hart Merriam, Chief of the Biological Survey, Washington, D. C., for his kind permission to reproduce the map of faunal areas, published in Bulletin 10 of the Survey.

THOREAU MUSEUM,
CONCORD, MASSACHUSETTS

Explanation of plates 1-7

PLATE 1

Life zones of the United States, by C. Hart Merriam. Orthochromatic reproduction of colored plate (U. S. Dep. Agric., Div. Biol. Survey, Bull. No. 10). All northern Canada, not shown on this map, is in the Boreal zone.

PLATE 2

1. *Usnea florida* (L.) Web. = [*Usnea vulgatissima*]. Dillenius' figure, Hist. Musc. *pl 13. f. 12, 13* 1741.

2 Specimen representing phase (*h*) from Herbarium Sullivant Moss Chapter.

3. Specimen representing highest type of development (slightly reduced) from herbarium of Dr. L. W. Riddle, Wellesley, Mass. (*Pringle, no. 10755*), collected in Cuyamaloza, State of Hidalgo, Mexico.

4. Fruiting branch of *Usnea florida* (L.) Web. (slightly reduced) showing normal development.

5. Microscopic photograph of cross-section of thallus of *Usnea florida*, showing axis cord, medulla, algal cells, and cortex with papillae.

PLATE 3

1. *Usnea plicata* (L.) Web ($\frac{1}{3}$ nat size). Represents the highest development found in eastern North America. Collected in Plymouth, N. H., March, 1901, and kindly loaned for reproduction by Dr. L. W. Riddle from the Herbarium of Wellesley College.

2. Specimen from St. Martinsville, La., kindly loaned by Professor Bruce Fink. Represents phase (*d*).

3. *Usnea plicata* (L.) Web. — [*Usnea vulgaris*]. Dillenius' figure, Hist Musc. *pl. 11. f. 1.* 1741.

4. *Usnea plicata* (L.) Web. Represents a portion of a plant ($\frac{1}{3}$ nat. size) showing the highest development attained (*U. californica* Herre). Specimen collected by Dr. M. A. Howe, April 5, 1893, Coast Range, Marin Co, Cal *No. 1163*, author's herbarium, kindly given by Dr. L. W. Riddle.

PLATE 4

1. *Usnea plicata barbata* (L.) R. H. Howe — [*Usnea barbata*] Dillenius' figure, Hist. Musc. *pl. 12. f. 6.* 1741. Reduced to about $\frac{1}{3}$.

2. *Usnea trichodea* Ach. Specimen *no. 324*, author's herbarium, collected Jan 7, 1907, Fitzwilliam, N. H., reduced to $\frac{1}{3}$ nat. size

3. *Usnea plicata barbata* (L.) R. H. Howe. Typical specimen representing normal development in northeastern North America ($\frac{9}{10}$ nat. size) Specimen from Westbrook, Me, collected Aug. 22, 1908. In the herbarium of the Portland Society of Natural History, kindly loaned by Mr. A. H. Norton.

4. *Usnea trichodea* Ach. Acharius' original figure, Meth Lich. 1803. Reduced nearly one half.

PLATE 5

1. *Usnea articulata* (L.) Hoffm — [*Usnea capillacea* & *nodosa*]. Dillenius' figure, Hist. Musc. *pl. 11. f. 4.* 1741.

2. *Usnea articulata* (L.) Hoffm. Specimen in the U. S. National Herbarium, probably from the British Isles. Kindly loaned by Assoc. Curator J. N. Rose.

3. *Usnea cavernosa* Tuck. Specimen *no 1148*, author's herbarium, from Brunswick, Me., Jan., 1909. Kindly sent by Dr. Manton Copeland.

4. Microscopic photograph of cross-section of thallus of *Usnea cavernosa*, showing axis cord, medulla, algal cells, and foveola.

PLATE 6

Usnea longissima Ach. Acharius' figure, Nova Act. Soc. Sci Upsal. 7: *pl. 7. f 5.* 1815. Reduced.

PLATE 7

1. *Usnea angulata* Ach., representing the highest development. Specimen from eastern Bolivia, Apolo, collected July 18, 1902, above 5500 ft. by Mr. R. S. Williams, New York Botanical Garden, and kindly loaned for reproduction.

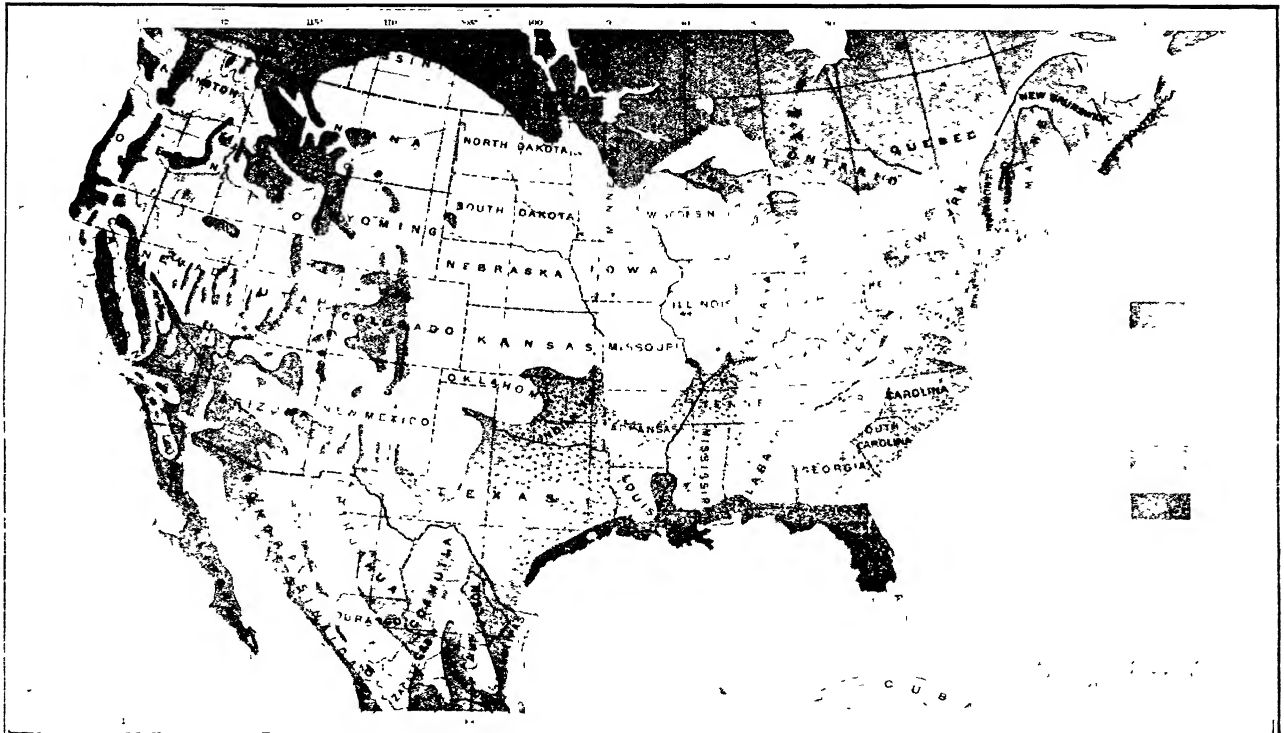
2. Specimen of *Usnea angulata* from Granville, Mass., collected by Miss Mary

Gill, May, 1895, showing reduced state in which it is found throughout the United States.

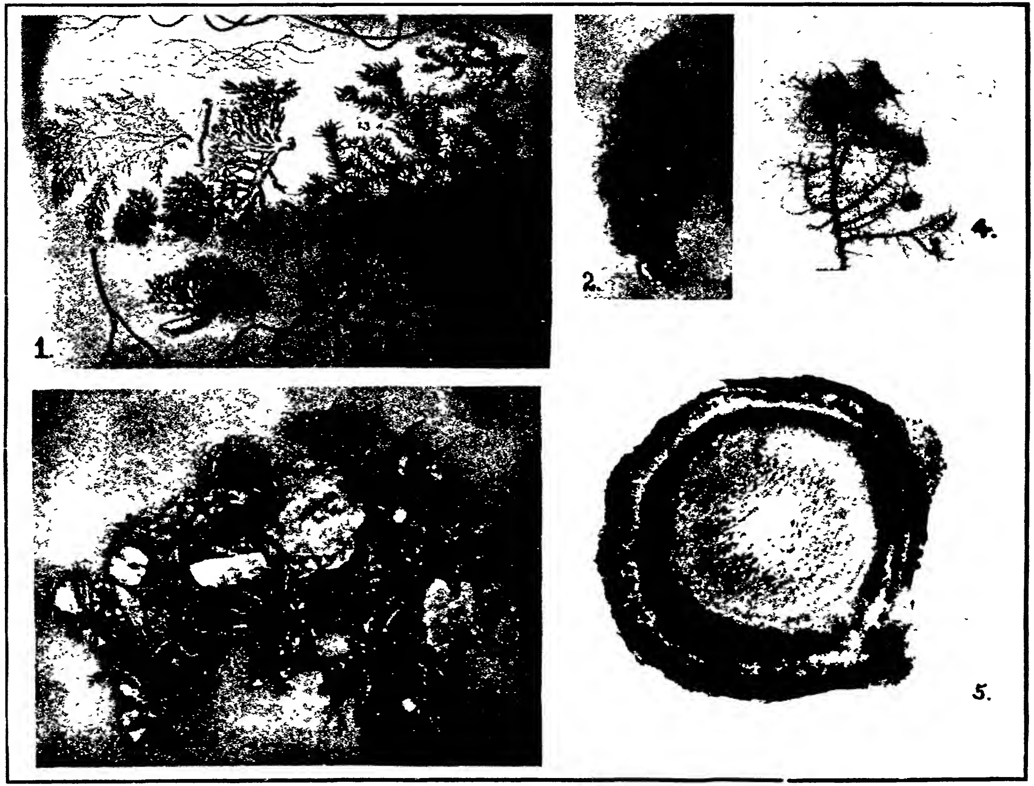
3. *Usnea longissima* Ach., representing the highest development. Specimen from Enterrottach und Vallepp bei Tegernsee, Germany, collected Sept. 3, 1898, by F. Arnold, and kindly loaned for reproduction from the private herbarium of Professor Bruce Fink, Miami University, Oxford, Ohio.

4. Specimen of *Usnea longissima* from Five Islands, Sagadahoc Co., Me., collected December 5, 1908, by Benjamin Rowe, showing reduced state in which it is found in the southeastern limits of its range.

All figures are ¾ the natural size.



LIFE ZONES OF THE UNITED STATES, ACCORDING TO C. HART MERRIAM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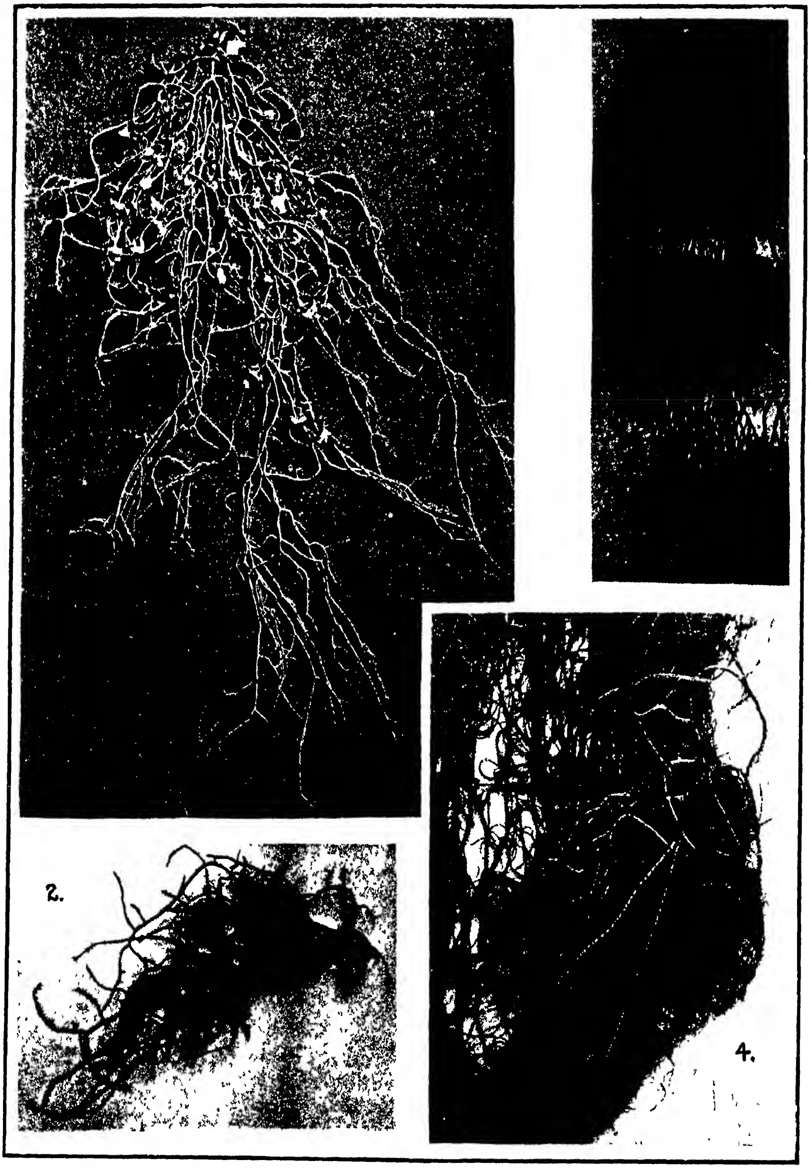
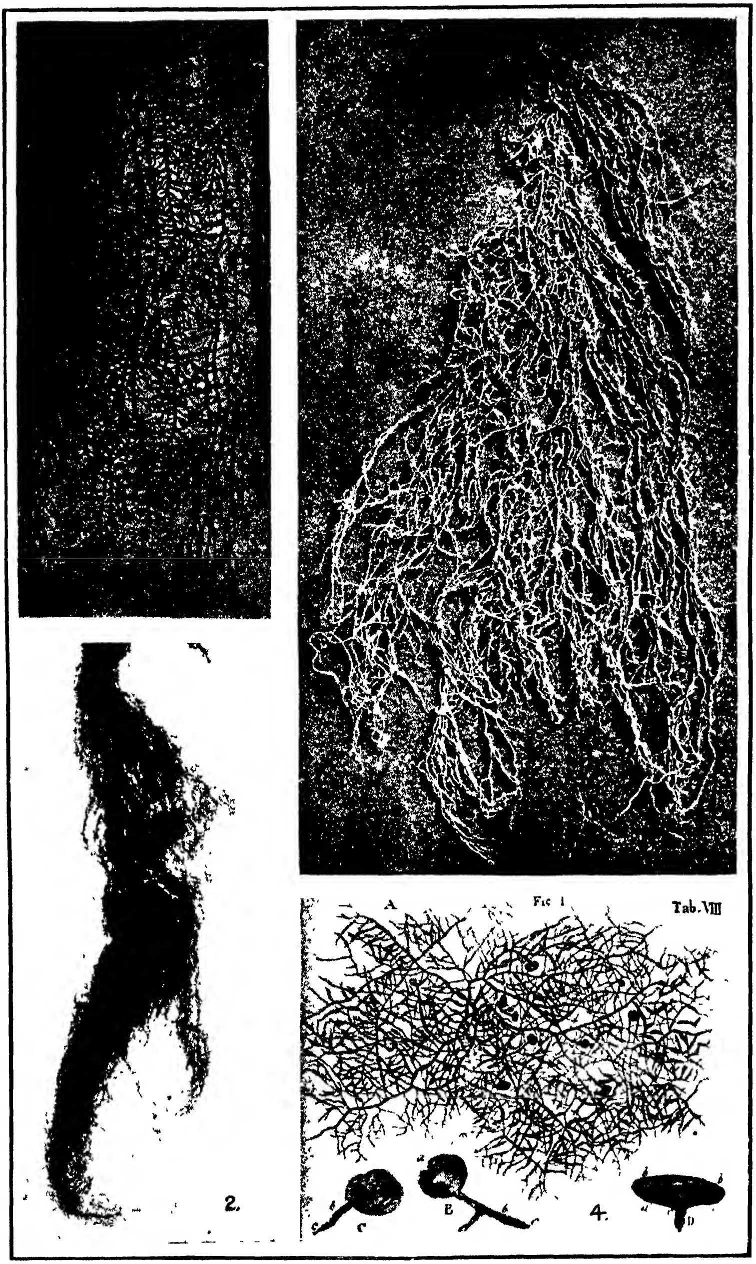
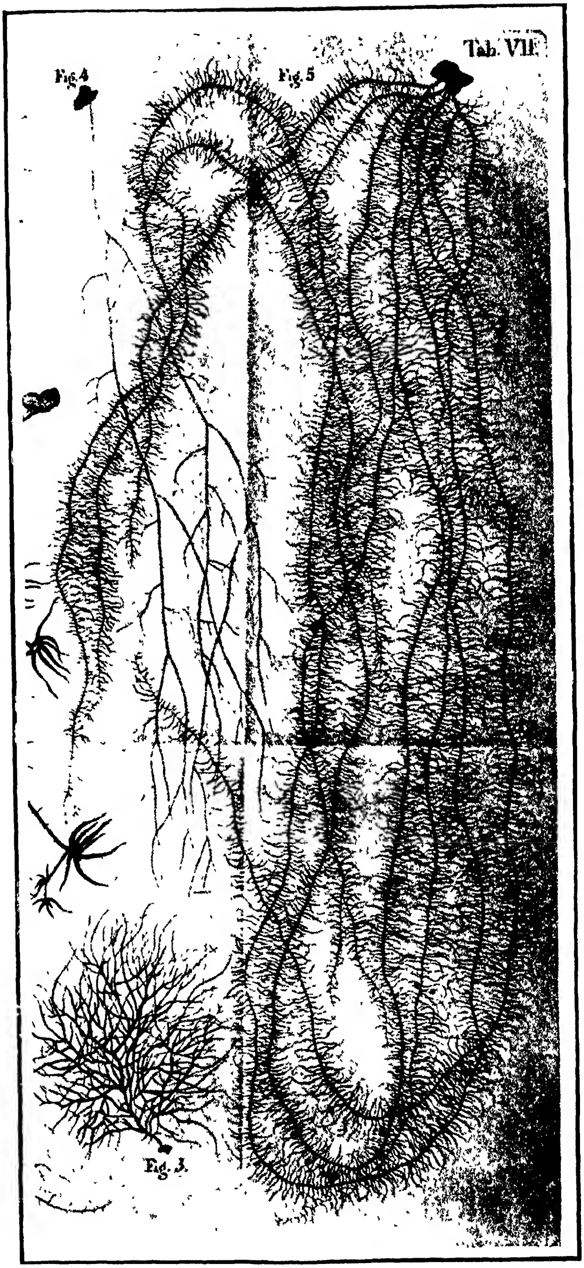


USNEA PLICATA (L.) WEB.

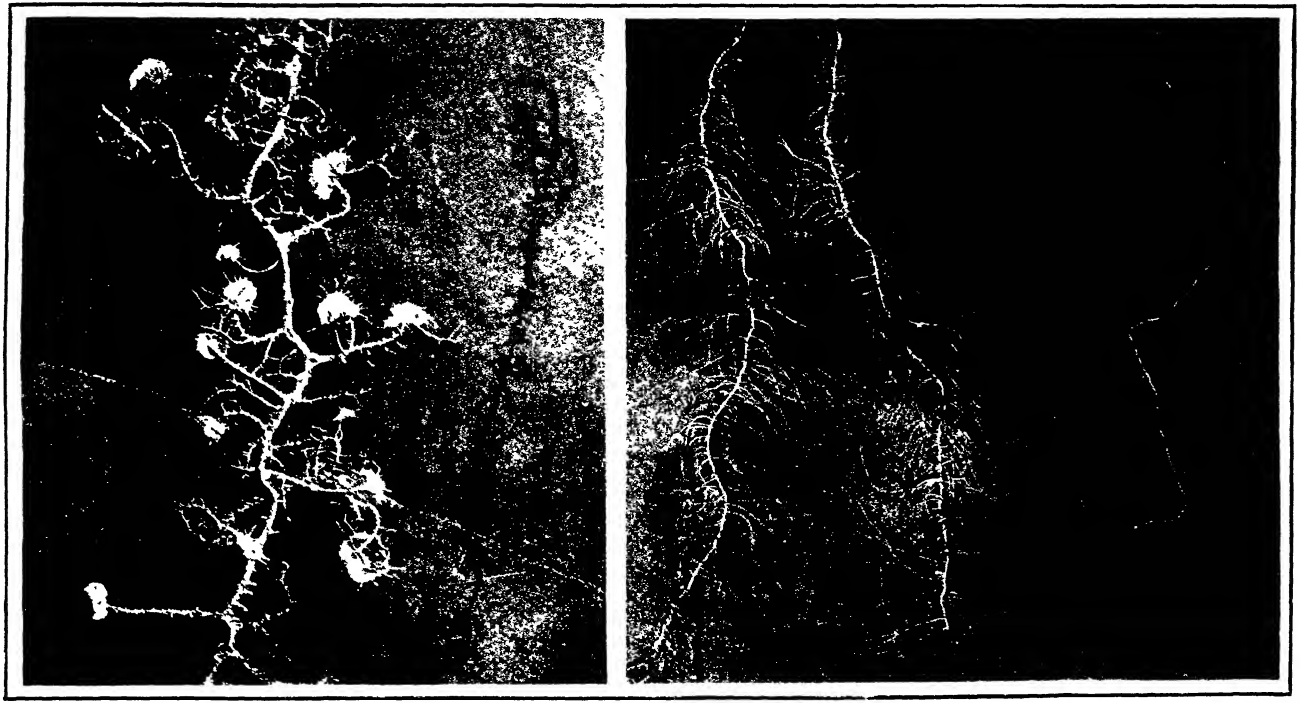


1, 3. USNEA PLICATA BARBATA (L.) R. H. HOWE
2, 4. USNEA TRICHODEA ACH.

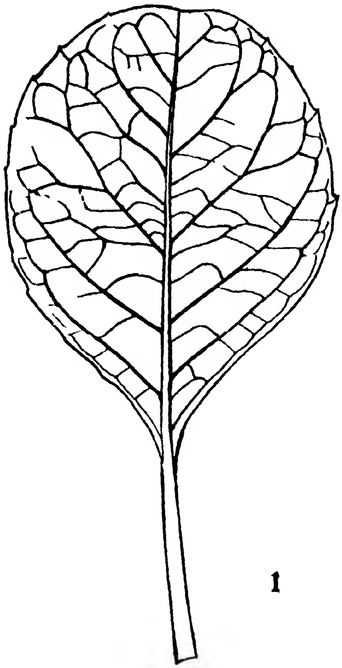
1, 2. USNEA ARTICULATA (L.) HOFFM.
3, 4. USNEA CAVERNOSA TUCK.



USNEA LONGISSIMA ACH (FIG. 5)



1, 2. USNEA ANGULATA ACH 3, 4. USNEA LONGISSIMA ACH.



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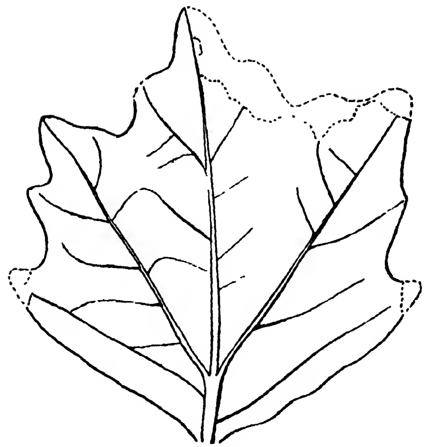

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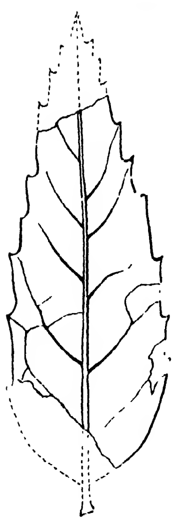

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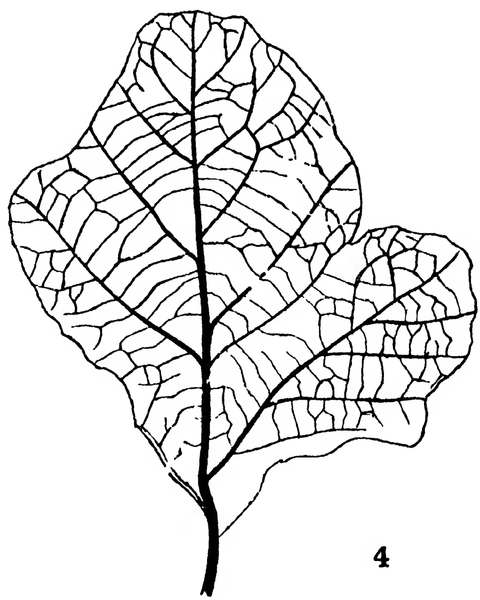

4

1. ELAEODENDRON MARYLANDICUM BERRY
2. HEDERA CECILENSIS BERRY
3. QUERCUS SEVERNENSIS BERRY
4. ARALIA WASHINGTONIANA BERRY.

Contributions to the Mesozoic flora of the Atlantic coastal plain—IV. Maryland *

Edward W. Berry

(with plate 8)

The present contribution is devoted to a brief description of some recent additions to the flora of the Magothy formation in the state of Maryland. The Magothy formation, arenaceous in this region and more or less argillaceous to the northeastward, has been found to contain an abundant flora. From beds of this age in New Jersey the writer has recorded 114 different species of fossil plants. In 1906 a brief contribution made known 41 species of fossil plants from beds of this age in Delaware and Maryland. The exact localities were Deep Cut on the C. & D. Canal just east of the Maryland state line with 32 species; Grove Point in Cecil County, Md., with 25 species; and Good Hope Hill near Washington in the District of Columbia, with one species. During the last three years descriptions of three additional species have been published, bringing the known flora in the Maryland area up to 44 species. The present contribution, which is to be regarded as preliminary in character, brings the total Magothy flora of Maryland up to 71 species and makes known several new localities. Many additional localities, as yet unexploited, will largely increase these figures. The present localities are Grove Point on the eastern shore of Chesapeake Bay in Cecil County at the extreme top of the formation; Round Bay and Little Round Bay on the Severn River in Anne Arundel County, also near the top of the formation; Brightseat in Prince George's County; and Good Hope Hill and Pennsylvania Avenue extended in the District of Columbia across the Anacostia River from Washington.

Synonymy is entirely omitted.

* Published by permission of the Maryland Geological Survey.

FILICALES

GLEICHENIA DELAWARENSIS Berry, Johns Hopkins Univ. Circ. II. **7**: 82. *f. 3, 3a.* 1907

This species, which was described recently from the Magothy formation at Deep Cut in Delaware, is also present at Grove Point, Md.

PINALES

BRACHYPHYLLUM MACROCARPUM Newb. Fl. Amboy Clays 51 (footnote). 1896

This wide-spread Upper Cretaceous conifer has already been recorded from Deep Cut, Delaware, so that it is not surprising that it should be collected at Grove Point, particularly as it has been recently collected by the writer to the southward in the Carolinas.

SEQUOIA REICHENBACHI (Gein.) Heer, Fl. Foss. Arct. **1**: 83. 1868

This very wide-ranging Mesozoic species occurs toward the top of the Magothy formation at Round Bay and at Little Round Bay on the Severn River. Both the foliage and three specimens of the characteristic cones were recently collected at Grove Point.

SEQUOIA AMBIGUA Heer, Fl. Foss. Arct. 3^1: 78. 1874

This characteristic species, while mainly a Lower Cretaceous form, ranges upward into the Atane beds of Greenland, the Magothy of Gay Head, and the Tuscaloosa of Alabama. The present record is based upon leafy twigs from Round Bay on the Severn River.

Moriconia americana sp. nov.

Moriconia cyclotoxon Deb. & Ettings.; Berry, Bull. N. Y. Bot. Gard. **3**: 65. *pl. 43. f. 4; pl. 48. f. 1–4.* 1903; Bull. Torrey Club **31**: 70. 1904; **33**: 165–167. 1906.

The conviction that the post-Raritan material of the Atlantic coastal plain referred to *Moriconia cyclotoxon* Deb. & Ettings. is specifically distinct from that species has grown with the increase in our knowledge. In 1903 the writer, in describing the material from Cliffwood Bluff, N. J., pointed out that it was uniformly one hundred per cent. more robust than in the European or earlier

American specimens. Similar large-sized forms have been discovered by the writer in the Magothy formation at Deep Cut, Delaware; Grove Point, Maryland; from the homotaxial Black Creek formation in North Carolina; and the Middendorf formation of South Carolina. The latter formation in particular contains an abundant representation of this species. It may be distinguished primarily by its invariably larger size, the relatively much shorter distichous twigs, and the universal presence in the material collected of leaves along the axis of the larger twigs. A new locality for Maryland is at Round Bay on the Severn River.

WIDDRINGTONITES REICHII (Ettings.) Heer, Fl. Foss. Arct. 6^2: 51. *pl. 28. f. 5.* 1882

This wide-spread conifer, previously recorded from the Maryland area at Deep Cut, Grove Point, and Overlook Inn, is present at Round Bay on the Severn River.

ARECALES

FLABELLARIA MAGOTHIENSIS Berry, Torreya **5**: 32. *f. 1, 2.* 1905

These fragmentary leaves of a Cretaceous fan-palm are present in the collections from Round Bay on the Severn River. The species has been previously recorded from the Magothy formation at Grove Point, Maryland; Deep Cut, Delaware; and pits of the Cliffwood Brick Company, New Jersey.

SALICALES

SALIX LESQUEREUXII Berry, Bull. Torrey Club **36**: 252. 1909

This well-known and wide-spread Upper Cretaceous form is contained in the collections from the Pennsylvania Avenue locality.

FAGALES

QUERCUS MORRISONIANA Lesq. Cret. & Tert. Fl. 40. *pl. 17. f. 1, 2.* 1883

This Cretaceous laurel oak was described by Lesquereux from the Dakota Group in Colorado. It has been recorded also from the Magothy formation at Cliffwood Bluff, N. J., and from Center Island, N. Y. The present material comes from Round Bay.

Quercus severnensis sp. nov.

Leaves of small size, ovate-lanceolate in outline, becoming gradually narrowed apically, 7 cm. in length by 2.3 cm. in greatest breadth, which is in the basal half of the leaf. Apex pointed. Base rounded. Petiole short and stout. Margin entire for its basal fourth, above which it is beset with distant, prominent, serrate teeth separated by inequilateral rounded sinuses. Midrib stout. Secondaries remote, 6–8 pairs, subopposite to alternate, branching from the midrib at angles of from 45° to 50°, but slightly curved, not prominent; basal ones sending branches into the teeth, distal ones running direct to the marginal teeth. (PLATE 8, FIGURE 3.)

This species is somewhat suggestive of the much older *Quercophyllum chinkapinensis* Ward of the Patapsco formation and it is closely related to *Quercus Holmesii* Lesq., of the Dakota Group of the West and the Magothy formation of New Jersey. Among modern oaks analogies may be found among the scrub and live oaks of the Pacific slope, as, for example, *Quercus Wislizeni*, *Quercus agrifolia*, *Quercus tomentella*, and *Quercus chrysolepis*, especially the first; and with *Quercus Ilex* of Europe. The single specimen comes from Round Bay on the Severn River.

RANALES

SASSAFRAS ACUTILOBUM Lesq. Cret. Fl. 79. *pl. 14. f. 12.* 1874

This common Cenomanian species is abundantly represented in the Magothy formation of Maryland. The present material is from Grove Point, Cecil County; Brightseat, Prince George's County; and the Pennsylvania Avenue locality in the District of Columbia.

SASSAFRAS CRETACEUM Newb. Later Ext. Fl. 14. 1868

This Dakota Group species is represented in the Magothy formation of Maryland by specimens from Brightseat, Prince George's County; and Overlook Inn Road and Pennsylvania Avenue extended in the District of Columbia.. It is of especial interest as a form reported by Stanton * in association with *Inoceramus labiatus* in the Woodbury formation of Iowa.

* Stanton, Bull. U. S. Geol. Surv. 106: 21. 1893.

MAGNOLIA OBTUSATA Heer, Fl. Foss. Arct. 6^2: 90. *pl. 15. f. 12; pl. 21. f. 3.* 1882

This species is confined to the Atane beds of Greenland, the Dakota Group of the West, and the Magothy formation of the Atlantic coastal plain. The present record is based on material from Grove Point, Cecil County.

MAGNOLIA LACOEANA Lesq. Fl. Dakota Group 201. *pl. 60. f. 1.* 1892

This is a Dakota Group species which reappears in both the Raritan and Magothy formations of the coastal plain. The present material comes from Grove Point in Cecil County.

MAGNOLIA LONGIPES Hollick, Bull. Torrey Club **21**: 60. *pl. 178. f. 3.* 1894

Specimens of the basal half of the leaves of this species, showing the characteristic outline, venation, and long stout petioles are present at Grove Point.

MAGNOLIA BOULAYANA Lesq. Fl. Dakota Group 202. *pl. 60. f. 2.* 1892

This common Upper Cretaceous species is present at Grove Point, the most southern locality at which it has been recognized in the East. Recent collections from Alabama show this species to have been a member of the Tuscaloosa flora. In the West it extends southward to Texas (Woodbine formation).

NELUMBO PRIMAEVA Berry, Bull. N. Y. Bot. Gard. **3**: 75. *pl. 43. f. 1.* 1903

This small species heretofore known from a single specimen found at Cliffwood Bluff in New Jersey occurs in the Upper Magothy at Round Bay on the Severn River.

ROSALES

PLATANUS HEERII Lesq. Ann. Rep. U. S. Geol. & Geog. Surv. Terr. **1871**: 303. 1872

This species, which was described originally from the Dakota Group of Kansas, was recorded by Heer from the Atane beds of

Greenland and by Dawson from the Mill Creek series of Canada. Lesquereux * reported it from Pettit's bank, South River, N. J. (Raritan), but it has never been found in the abundant Raritan materials examined by the late Professor Newberry or the writer and it is probably not a member of the Raritan flora. Fragmentary leaves of this species are common in the Magothy formation at the Pennsylvania Avenue locality.

COLUTEA PRIMORDIALIS Heer, Fl. Foss. Arct. 6^2: 99. *pl. 27. f. 7–11; pl. 43. f. 7, 8.* 1882

Characteristic leaves of this species occur at Grove Point, Cecil County.

LEGUMINOSITES CORONILLOIDES Heer, Fl. Foss. Arct. 3^2: 119. *pl. 34. f. 14.* 1874

This Upper Cretaceous species, which is recorded from the Dakota Group of Kansas, the Atane beds of Greenland and the Raritan and Magothy formations of the Atlantic coastal plain, is present at Grove Point in Cecil County.

LEGUMINOSITES OMPHALOBIOIDES Lesq. Fl. Dakota Group 149. *pl. 38. f. 4.* 1892

This species, previously recorded from the Dakota Group of Kansas and the Raritan formation of New Jersey, is present in the Magothy formation at Grove Point.

SAPINDALES

Elaeodendron marylandicum sp. nov.

Leaf orbicular in general outline, 6.5 cm. to 8.5 cm. in length by 4.7 cm. to 6.2 cm. in greatest width, which is about midway between the apex and the base. Apex evenly rounded, somewhat emarginate in one specimen. Base cuneate, slightly decurrent. Margin entire below, furnished above with a few irregularly spaced and very small spine-like teeth. Petiole extremely stout, 3 cm. long in one of the smaller specimens. Midrib also stout, thinning rapidly toward the tip. Secondaries 5 or 6 pairs, alternate, camptodrome, branching from the midrib at an angle of about 50° to 55° and curving slightly upward to join lateral branches from the

* Cook, Report on the clay deposits of Woodbridge, South Amboy, and other places in New Jersey 29. 1878.

secondaries next above. From the outer side of these successive arches short tertiaries run to the marginal teeth in those parts of the leaf in which the teeth are developed. (PLATE 8, FIGURE 1.)

This very handsome and well-marked species is represented by a number of specimens from Grove Point. It finds its nearest relative in certain of the larger and more orbicular variants of the Upper Raritan and Magothy species, *Celastrophyllum Newberryanum* Hollick; in fact, it would seem reasonable to suppose that the present species, which has thus far been found only at the extreme top of the Magothy formation at Grove Point, may be descended from *Celastrophyllum Newberryanum*, which characterizes particularly the Upper Raritan at South Amboy, New Jersey. The writer was long undecided whether or not to refer the new species to *Celastrophyllum* or *Elaeodendron* and it may also seem preferable eventually to transfer *C. Newberryanum* to the latter genus, with which it shows many characters in common. The present species may be compared with *Elaeodendron dioicum* Griseb., from the West Indies. The genus *Elaeodendron* has mainly a Tertiary history, although Hollick has described a Magothy species recently from Gay Head (*Elaeodendron strictum*).*

RHAMNALES

Cissites formosus magothiensis var. nov.

While *Cissites formosus* as identified by Heer, Lesquereux, and Newberry is a form of considerable variability, the Magothy variety, which comes from Grove Point, is sufficiently distinct to deserve at least a varietal name. It lacks the long bifurcated lateral lobes of the type and has an elongated terminal lobe, the whole less sublobate than in the type material.

RHAMNITES APICULATUS Lesq. Fl. Dakota Group 171. *pl. 37. f. 8–13.* 1892

This Dakota Group species is present in the collections from Round Bay on the Severn River.

* Hollick, Mon. U. S. Geol. Surv. 50: 89. *pl. 33. f. 6.* 1907.

MYRTALES

EUCALYPTUS GEINITZI (Heer) Heer, Fl. Foss. Arct. 6[2]: 93. *pl. 19. f. 1c, et seq.* 1882

This wide-spread species and the variety described by Newberry as *Eucalyptus angustifolia* are both contained in the collections from Round Bay and Little Round Bay on the Severn River, and from Grove Point in Cecil County.

EUCALYPTUS LATIFOLIA Hollick, Mon. U. S. Geol. Surv. 50: 97. *pl. 36. f. 1–5.* 1907

This large leaf, described by Hollick from Gay Head, Marthas Vineyard, and Glen Cove, Long Island, as a species of *Eucalyptus*, is contained in the collections from Round Bay on the Severn River.

THYMELEALES

LAURUS HOLLICKII Berry, Bull. N. Y. Bot. Gard. 3: 79. *pl. 52. f. 4.* 1903

This species, which is already recorded from Grove Point, is present also in the collections from Round Bay on the Severn River.

LAURUS PROTEAEFOLIA Lesq. Bull. U. S. Geol. & Geog. Surv. Terr. 1: 393. 1876

This Dakota Group species, which was previously recorded from the Magothy formation in New Jersey, is present in Maryland at Grove Point and at Round Bay on the Severn River.

LAURUS PLUTONIA Heer, Fl. Foss. Arct. 6[2]: 75. *pl. 19. f. 1d, 2–4, etc.* 1882

This Upper Cretaceous laurel, which was previously known from Grove Point, Maryland, occurs also at Round Bay on the Severn River.

LAUROPHYLLUM ELEGANS Hollick, Mon. U. S. Geol. Surv. 50: 81. *pl. 27. f. 1–5.* 1907

Remains of this species, described originally from the morainic material at Tottenville, Staten Island, and Glen Cove, Long Island, are present at Grove Point and common at Round Bay on the Severn River.

CINNAMOMUM INTERMEDIUM Newb. Fl. Amboy Clays 89. *pl. 29. f. 1–8, 10.* 1896

Previously recorded from the Magothy formation in New Jersey, Delaware, and Maryland, this species occurs at Round Bay and at Little Round Bay on the Severn River.

UMBELLALES

CORNUS FORCHHAMMERI Heer, Fl. Foss. Arct. 6^2: 85. *pl. 44. f. 13.* 1882

The Grove Point leaf upon which this record is based is a trifle narrower than the type, otherwise the two are identical. *Cornophyllum vetustum* Newb., from the New Jersey Raritan, is possibly the same species. The features in which the Maryland leaf differs from that of Newberry are its more lanceolate form; the symmetrical base; the fewer secondaries, which form a much more acute angle with the midrib and are more regular in their course; the presence of the transverse tertiaries, which are invisible in the Raritan leaf; the more regular margin, the longer petiole, stouter midrib, and coarser secondary system. All of these characters are features in which the Raritan leaf departs from the typical leaves of *Cornus*. The present species is closely allied to *Cornus praecox* Lesq., of the Dakota Group.

ARALIA RAVNIANA Heer, Fl. Foss. Arct. 6^2: 84. *pl. 38. f. 1, 2.* 1882

This remarkable species of *Aralia*, described originally from the Atane beds of Greenland by Heer, was recorded by the writer from the Magothy formation at Cliffwood Bluff, N. J., where it is represented by a number of imperfect but characteristic leaves. It has also been recorded by Hollick from Gay Head, Marthas Vineyard, and from Tottenville, Staten Island, but these latter occurrences are based upon material of a very doubtful character.

The present record is based upon unequivocal material from Grove Point. The species is closely allied to *Aralia Towneri* Lesq. of the Dakota group.

Aralia washingtoniana sp. nov.

Leaves of medium size, broadly trilobate, about 8–10 cm. in length by 8 cm. in greatest width. Sinuses shallow and rounded. Lobes broadly rounded. Petiole and midrib stout. Lateral

primaries scarcely to be distinguished from the secondaries. Secondaries 4 or 5 subopposite pairs, rather straight, indifferently camptodrome or craspedodrome. Tertiaries well marked, transverse. Margins entire. (PLATE 8, FIGURE 4.)

The remains of this species are numerous but fragmentary. In general outlines and venation they suggest a species of *Aspidiophyllum* but they lack the characteristic base of that genus. There is some resemblance, not close however, to *Aralia rotundiloba* Newb., and to *Aralia nassauensis* Hollick.

Collected at the Pennsylvania Avenue locality in the District of Columbia.

Hedera cecilensis sp. nov.

Leaves of medium size, orbicular in general outline with a tendency toward trilobation, 6–7 cm. in length by about 6 cm. in greatest width. Margin entire, with shallow undulate lobes. Petiole and midrib stout. Lateral primaries suprabasilar, not differentiated from the secondaries in some specimens. Secondaries one pair below the lateral primaries and one or two remote pairs above, forking dichotomously and craspedodrome in habit. (PLATE 8, FIGURE 2.)

This species resembles in a general way several which Lesquereux referred to *Cissites*, as for example *Cissites Harkerianus* and *Cissites acuminatus*. In appearance it suggests the somewhat larger Dakota Group leaf which Lesquereux christened *Platanus cissoides*. It is closely related to *Hedera cretacea* Lesq., differing in the suprabasilar primaries and in the details of the general outline. *Hedera cecilensis* is a very well marked species and is evidently allied to *Hedera*, clearly differentiated however from any of the previously described forms. The genus is rather prominent in Upper Cretaceous floras, both in Europe and America, the present species and *Hedera cretacea* Lesq. resembling closely the existing species. The present material is from Upper Magothy at Grove Point in Cecil County, from which it takes its name.

ERICALES

ANDROMEDA GRANDIFOLIA Berry, Bull. Torrey Club **34**: 204. 1907

This species, previously recorded from Long Island, New Jersey, North Carolina, and Alabama, is present in the collections from Grove Point.

ANDROMEDA NOVAE-CAESAREAE Hollick in Newb. Fl. Amboy Clays 121. *pl. 42. f. 9–12, 28–31.* 1896

This characteristic Magothy form, previously recorded from Grove Point in Maryland, is also present at Round Bay on the Severn River.

ANDROMEDA COOKII Berry, Bull. Torrey Club 36: 261. 1909

Recent collections show this species to be present at both Grove Point and at Round Bay on the Severn River.

ANDROMEDA PARLATORII Heer, Phyll. Crét. d. Nebr. 18. *pl. 1. f. 5.* 1866

Previously recorded from Deep Cut and Grove Point in the Maryland region, this widespread Upper Cretaceous species is present at Round Bay on the Severn River.

PRIMULALES

MYRSINE BOREALIS Heer, Fl. Foss. Arct. 3^2: 113. *pl. 32. f. 23.* 1874

Typical material of this common Cenomanian species is contained in the collections from Grove Point.

Explanation of plate 8

FIG. 1. *Elaeodendron marylandicum* Berry. Grove Point, Md.
FIG. 2. *Hedera cecilensis* Berry. Grove Point, Md.
FIG. 3. *Quercus severnensis* Berry. Round Bay, Md.
FIG. 4. *Aralia washingtoniana* Berry. Pennsylvania Ave., D. C.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MD.

The larkspurs of New Mexico

Elmer Ottis Wooton

Until quite recently the species of *Delphinium* found in New Mexico have all been referred to *D. azureum* Michx., *D. scopulorum* Gray, or *D. occidentalis* Wats., with a general tendency to call all the large forms *D. scopulorum.* I myself have been responsible for sending out at least two very different plants under that name, neither of which was close to true *D. scopulorum.* Dr. P. A. Rydberg, Dr. Aven Nelson, and Professor T. D. A. Cockerell have each contributed something towards a proper understanding of the genus as it occurs in this Territory, but they have been concerned with other questions than the New Mexican species and have touched them only incidentally.

Recently I had occasion to name a specimen from the Black Range, and in comparing it with our herbarium material my "eyes were opened" and I saw that there were various and different specimens labeled *D. scopulorum*, more forms than could properly belong in what Dr. Gray called "a collective species." Whether these various different kinds of plants are to be called different species, varieties, or races is a question which has not yet been decided, but it seems to me proper to call attention to the differences which I think can be seen by any one who is sufficiently interested to look, and I shall follow my own solution of the above question and call them species. Others may do as they like in designating the degrees of differentiation.

Through the kindness of Dr. J. N. Rose I was permitted to examine the New Mexican specimens of this genus that are found in the National Herbarium. Among these are Wright's *no. 842*, which is the type of *D. scopulorum* Gray, and Pringle's *no. 1184*, the type of *D. tenuisectum* Greene, besides several other interesting and instructive specimens.

Our herbarium contains about one hundred sheets, more than half of which are from New Mexico. A critical examination of this and the National Herbarium material, along with the literature of the subject, has led to the following conclusions.

Delphinium occurs in New Mexico mainly as a plant of the higher, timber-covered mountains and in these locations is represented by the tall leafy-stemmed forms only. None of the specimens seen represent any of the small tuberous-rooted blue-flowered species. The species found in such places belong to what may be called the *scopulorum* and the *occidentale* groups. On the plains at the southern end of the Territory occurs *D. camporum* Greene. According to Dr. Greene this species is to be looked for on the plains east of the Rocky Mountains from New Mexico to Wyoming, but the material I have seen does not show it from any point in this Territory north of the southern third; and these specimens do not agree exactly with the original description of the species.

The material seems to indicate that the species are nearly related, and have relatively small areas of distribution over which they are not variable. Widely separated mountain ranges seem to be occupied by separate species.

Key to the species

Plants low, with leaves forming a cluster about the base; stem-leaves few and small, or none.
- Flowers whitish or light-colored .... 1. *D. camporum.*
- Flowers blue.
  - Leaves with numerous narrow segments; inflorescence short, flowers small and crowded .... 2. *D. confertiflorum.*
  - Leaves few, with thickish segments; inflorescence scape-like, flowers rather large and scattered .... 3. *D. scaposum.*

Plants tall, 1 m. or more, with leafy stems.
- Segments of the leaves more or less oblong to linear, abruptly acute, only the basal segments pronouncedly cuneate; pubescence of short curled hairs closely appressed, rarely if ever glandular.
  - Bracts of the inflorescence expanded and at least the lowest resembling the foliar leaves .... 4. *D. amplibracteatum.*
  - Bracts of the inflorescence narrowly linear.
    - Plants of medium height, about 1 m.
      - Ultimate segments of the leaves oblong .... 5. *D. scopulorum.*
      - Ultimate segments of the leaves narrowly linear .... 6. *D. tenuisectum.*
    - Plants more robust, 2 m. high or more .... 7. *D. robustum.*
- Segments of the leaves more or less narrowly diamond-shaped in outline with acute or acuminate apex and cuneate base; pubescence of spreading hairs, more or less glandular, at least in the inflorescence (except in No. 8).
  - Flowers deep blue.
    - Sepals acuminate .... 11. *D. Cockerellii.*

Sepals not acuminate, at least a part of them obtuse.
Leaf segments broad, leaves yellowish green ... . 12. *D. macrophyllum.*
Leaf segments very narrow, leaves dark green above ; pubescence of the *scopulorum* section................................ 8. *D. novo-mexicanum.*
Flowers dull brownish- or greenish-purple.
Leaf segments broad (1–2 cm.)................... 10. *D. Sapellonis.*
Leaf segments narrow (7 mm. or less)......... 9. *D. Sierrae-Blancae.*

1. DELPHINIUM CAMPORUM Greene, Erythea 2: 183. 1894

Type locality: "A plant of dry sandy plains along the eastern base of the whole Rocky Mountain range, apparently from British America to Mexico."

I have not seen type material of this species, but from what I find of other species of this region it seems doubtful to me that a species occurring on the plains of Wyoming would occur in southern New Mexico. In a paper discussing the members of the *azureum* group of the genus,* Dr. Rydberg has referred two New Mexican specimens to the species under discussion. These are Thurber's *no. 291* from the Jornado del Muerto and Rusby's *no. 5* from Mangas Springs. Thurber's specimen I have not seen, but Rusby's matches the following specimens:

Mangas Springs, New Mexico, May 24, 1903, *Metcalfe 85.*
Flats near Nutt, New Mexico, May, 12, 1905, *Metcalfe 1579.*
Las Cruces (probably Organ Mts.), June, 1898, *Herrick 215.*
Organ Mts., New Mexico, May 26, 1905, *Wooton.*

Besides these, I have also the type of *D. Wootoni* Rydb.,* which is from the Organ Mts., and it seems to me hardly separable from the above named specimens. The Jornado del Muerto (a wide open plain about 75 miles long) ends at the Organ Mts. and it is likely Thurber collected his plant not very far from these mountains. If Dr. Rydberg is incorrect in assigning his New Mexican specimens to *D. camporum* Greene, all this material becomes *D. Wootoni* Rydb.; otherwise the latter name becomes a synonym.

2. **Delphinium confertiflorum** sp. nov.

Plant low, 20 to 30 cm. high, tufted, from a perennial root, finely appressed-pubescent throughout with short white hairs;

* Bull. Torrey Club 26: 583 and 587. 1899.

lower leaves with elongated petioles, 10 cm. long or less, almost erect, their bases wing-margined and clasping the stem, upper leaves on petioles about 1 cm. long, blades of all the leaves circular in outline, 3 cm. or less in diameter, twice or thrice parted, the ultimate segments linear-oblong and divergent, with acute callus-tipped apices; inflorescence short, strict or slightly panicled, pedicels 1 cm. long or less; bracts of the inflorescence linear-lanceolate, half as long as the pedicels and adnate to them for a short distance at the bases, floral bracts minute, attached just below the receptacle; flowers small, 10 to 15 mm. long, bright blue, crowded, spur slightly longer than the sepals, bent downward at the tip, horizontal or ascending; sepals all broadly elliptic, obtuse, the uppermost shortest and broadest, mostly without saccate callosities at the tips; upper petals expanded at the tip, entire, blue, white on the lower edge, limb of the lower petals oblong, entire or retuse, not bifid, claw rather broad, spur at the base 1 mm. long; mature fruit not seen, young follicles appressed-pubescent like the other parts.

Type collected by E. O. Wooton in the mountains 15 miles southeast of Patterson, New Mexico, near Culbertson's Ranch, in pine forest, Aug. 16, 1900, at an altitude of about 2300 m.

The crowded racemes of small blue flowers suggest a relationship to *D. strictum* A. Nels., but our plant is even smaller, has a different kind of pubescence, and its leaves, clustered about the base of the stem, are more like those of *D. Geyeri* Greene, though the segments are narrower and stiffer; the flowers are smaller and lighter-colored than those of *D. Geyeri* and the stem less scape-like. It probably is more nearly related to *D. camporum* Greene, though the flowers are very different.

3. DELPHINIUM SCAPOSUM Greene, Bot. Gaz. **6**: 156. 1881.

Type locality: "Hill country between the Gila and San Francisco rivers," New Mexico.

I have never collected this plant in New Mexico, though I have been in the region above mentioned on two separate occasions.

The following plants probably belong to the species:

Coolidge, New Mexico, June 20, 1887, *Tracy* (U. S. Nat. Herb., sheet *no. 219,226*).

Chusca Mts., New Mexico, June 24, 1883, *Marsh* (U. S. Nat. Herb., sheet *no. 2007*).

Defiance, New Mexico, June 18, 1883, *Marsh* (U. S. Nat. Herb., *no. 1997*).

Rim of the Grand Cañon (Grand View), Arizona, July 12, 1892, *Wooton.*

Mancos, Colorado, June 24, 1898, *Baker, Earle, & Tracy, 79.*

A small scrap of a *Delphinium* collected by W. B. Pease in New Mexico (*loc.* ?) in 1878 (U. S. Nat. Herb., sheet *no. 125,931*) belongs in this group, but the material is too scanty for identification with the means at my command.

4. **Delphinium amplibracteatum** sp. nov.

An erect tall plant, appressed-pubescent throughout; leaves palmately deeply 5-parted into narrowly oblong or cuneate lobes, these again lobed and toothed into narrow oblong divergent divisions or teeth, the ultimate divisions from 3–5 mm. broad, abruptly rounded and tipped with a small callosity, about equally pubescent on both surfaces with short, curled white hairs; inflorescence a strict raceme about 40 cm. long, the lower pedicels 5 cm. long, the upper ones bearing open flowers but 1 cm. long; bracts extremely variable, those of the inflorescence below leaf-like, twice 3-lobed, making the flower appear axillary, those of the middle of the raceme oblanceolate, few-toothed, 2–3 cm. long, attached to the middle of the pedicels; those toward the top of the raceme smaller and entire, but never linear and acuminate like the bracts of its nearest allies; floral bracts showing the same variation, the lowermost being foliaceous and toothed, only the upper ones being acuminate; flowers bright blue, about 2 cm. long, all parts which are outside in the bud appressed-pubescent, spur slightly longer than the sepals, rather slender, straight, horizontal or ascending; sepals elliptic, obtuse, the uppermost slightly narrower, each with a pronounced saccate callus at the apex; upper petals blue above, greenish white below; lower petals broadly oblong, irregularly 2–3-toothed, not deeply bifid; ovary appressed-pubescent, not viscid; mature fruit not seen.

Type collected by E. O. Wooton at the N Bar Ranch in the Mogollon Mountains, Aug. 2, 1900, at an altitude of about 2100 m. in open pine forest.

This description rests upon a single specimen and but for the peculiar bracts I should not name it. I have waited in vain for several years for more material, but the region is so difficult to get to that no collector has been there since. The material is

well preserved and seems amply distinct. It is evidently related to *D. scopulorum.*

5. DELPHINIUM SCOPULORUM A. Gray, Pl. Wright. 2: 9. 1853

Type locality: "Mountain ravines near the Mimbres, New Mexico." Most of the material which has been passing as *D. scopulorum* is not very closely related to that species if Wright's *no. 842*, as seen in U. S. Nat. Herb., sheet *no. 2027*, is to be taken as typical. I have never, to my knowledge, seen the plant growing, though I have been in the type locality once and near there three times. I have seen but one other specimen that I unhesitatingly refer to the species, Metcalfe's *no. 1093* from Kingston, which was distributed as *D. calophyllum* Greene, a description of which was never published.

Two other specimens of my own collecting may be referred to this species provisionally. One is from Wheeler's Ranch on Apache Creek in western Socorro County, collected July 12, 1906, and the other was taken on Sec. 17, T. 9 N., R. 12 W., near Agua Fria Spring, July 28, 1906. Neither is typical. My material consists of but two specimens of each number and no doubt each pair of specimens is from the same plant.

6. DELPHINIUM TENUISECTUM Greene, Erythea 2: 184. 1894

Type locality: "Chihuahua, cool banks of ravines, plains at the base of the Sierra Madre."

Dr. Greene is correct when he says that this species is nearest to *D. scopulorum*, and the New Mexican material seems to approach a little nearer to that species than do Mexican specimens. All the specimens here referred to have the narrow leaf-segments of the species.

The specimens seen are as follows:

Santa Rita, *Wright 842* (U. S. Nat. Herb., sheet *no. 2014*).

Near West Fork of Gila, Mogollon Mts., Aug. 3, 1903, *Metcalfe 364.*

Middle Fork of Gila, Mogollon Mts., Aug. 5, 1900, *Wooton.*

Mountains southeast of Patterson, Aug. 16, 1900, *Wooton.*

Mountains west of Grant, Aug. 2, 1892, *Wooton.*

Near Colonia Garcia, Sierra Madre of Chihuahua, Aug. 9, 1899, *Townsend & Barber 138.*

7. DELPHINIUM ROBUSTUM Rydb. Bull. Torrey Club **28**: 276. 1901

Type locality: "Wahatoya Creek, below the Spanish Peaks," Colorado.

I have not seen authentic material of this species, but Dr. Rydberg cites a specimen collected at Ratón in 1846 by Abert.

We have, in our herbarium, two sheets of a specimen collected in Chicorico Cañon near Raton, New Mexico, by Professor Cockerell, Aug. 25, 1900, which I am at present unable to place. I took it to be *D. robustum* Rydb., but Dr. Rydberg feels sure that this determination is incorrect, and is inclined to believe that my proposed *D. novo-mexicanum* is his *D. robustum*. There is but one argument (in the present state of our knowledge) in support of my opinion that they are probably separate species, and that is the rather large distance between their distribution areas and lack of specimens of the species from intermediate points where it might be expected; one or two such places having been visited by capable botanists who obtained other species of the genus but not this one (if it be one).

Being unacquainted with Professor Cockerell's plant in the field I hesitate to name it as new, though Dr. Rydberg thinks it such. I believe that a specimen collected by Mr. C. C. Marsh, Sept. 2, 1883, in "Chusa" (Chusca?) Valley, New Mexico (U. S. Nat. Herb., sheet *no. 2034*), and two others from Sierra Grande, New Mexico, collected by Mr. Arthur H. Howell, Aug. 15, 1903, *nos. 218* and *228* (U. S. Nat. Herb., sheets *no. 495,103* and *495,113*) are the same as Professor Cockerell's plant.

8. **Delphinium novo-mexicanum** sp. nov.

Plant perennial, with strict stems 1–2 m. high, glabrous up to the inflorescence, bluish along one side and slightly glaucous; leaves circular in outline, 8–15 cm. in diameter, palmately parted into 5–7 narrowly cuneate segments and these again cleft and parted into a number of lanceolate, divergent, acuminate lobes, evenly and finely appressed-pubescent throughout, dark green above, much lighter below; petioles of the lower leaves 10–15 cm. long, slightly winged at the base; inflorescence elongated, 2–5 dm. long, at first strict and flowers crowded, later becoming paniculate, the pedicels elongating a little in fruit, peduncles, pedi-

cels, and exterior of the flowers appressed-pubescent with short curled hairs, not glandular or viscid; bracts linear, one fourth to three fourths as long as the pedicels, free at the base of the pedicels or sometimes adnate part of the way up, floral bracts small, very slender, attached 2–5 mm. below the slightly enlarged receptacle; flowers 1–2 cm. long, spur about 10 mm. long, slightly curved, horizontal or ascending; sepals all elliptic-ovate, with a small saccate callus near the apex, dark blue, the upper and lower two sepals acute, the others obtuse; upper petals thickish and stiff, minutely 2-toothed at the apex, white along the lower margin, otherwise all petals blue, limb of the lower petals deeply bifid into lanceolate, rather acute lobes, long and white-hairy on upper surface, claw channeled and with a saccate protuberance 1 mm. long at the base, glandular-pubescent on the back; follicles about 1 cm. long, appressed-pubescent, not viscid, veins conspicuous, moderately divergent; seeds (immature?) irregular, angled, and distinctly winged, not scaly.

The type is in the herbarium of the New Mexico College of Agriculture and Mechanic Arts, collected by E. O. Wooton near Cloudcroft, Otero Co., New Mexico, July 31, 1899, at an altitude of about 2700 m. in open coniferous forests. Several other specimens from the type locality, and the two following are to be referred here:

Near Mescalero Agency, White Mts., July 27, 1897, *Wooton 219*.

Little Creek, White Mts., July 30, 1899, *Turner 95*.

Delphinium novo-mexicanum seems to be related most closely to *D. robustum* Rydb. and may even prove to be a form of that species.

9. **Delphinium Sierrae-Blancae** sp. nov.

Quite similar in general appearance to *D. novo-mexicanum* but differing in the following particulars: Leaf segments a little broader and of the same color on both surfaces; bracts at the base of the pedicels much longer, from once to twice the length of the pedicels, the floral bracts larger and attached to the thickened base of the receptacle; pubescence more copious and of longer crinkled hairs noticeably viscid on the flowers; callosities of the sepals wanting; sepals sometimes all acute, dull purplish green, drying as if the specimens were partly spoiled in pressing; upper petals part blue and part white, lower petals not so deeply cleft, purple, with a tuft of yellow hairs on the face; young follicles

appressed-pubescent; follicles * cylindrical, 12–15 mm. long, finely pubescent and viscid; seeds dark brown, irregularly oblong to triangular, scarcely winged.

The typical material comes from the upper slopes of the White Mountain Peak at elevations of from 3,200 m. down to about 2,500 m. The specimens seen are:

White Mt. Peak, Aug. 1, 1901, *Wooton.*

Townsend's *no. 26* (referred to in footnote), Aug., 1898.

Head of South Eagle Creek, Aug. 11, 1899, *Turner 192.*

Near Gilmore's Ranch on Eagle Creek, *Wooton,* July 14, 1895, and *Wooton & Standley,* Aug., 1907, *nos. 3661* and *3490.*

This is the common species of the higher altitudes of the White Mountains of Lincoln Co., and may shade gradually into *D. novo-mexicanum.* Extreme forms of the two species are amply distinct. It has the habit of that species but also shows some relation to *D. Sapellonis* in color of flowers, pubescence, and color of leaves.

10. DELPHINIUM SAPELLONIS Cockerell, Bot. Gaz. **34**: 453. 1902

Type locality: "Beulah, Sapello Cañon," New Mexico.

This is apparently the common species of the extensive mountain region which lies between Santa Fé and Las Vegas. The following specimens were seen:

U. S. Nat. Herb., sheet *no. 413,057;* the type specimen.

Mountains near Las Vegas, July, 1881, *Vasey.* Two sheets, U. S. Nat. Herb. *nos. 2180* and *125,892.*

Two other sheets collected by Professor Cockerell at Beulah.

Gallinas Cañon, near Las Vegas, July, 1908, *Bartlett 294.*

Upper Pecos River, Sept., 1904, *Bartlett 49.*

Upper Pecos River, Aug. 6, 1898, *Maltby & Coghill 130.*

Pecos River, National Forest, Winsor Creek, July 28, 1908, *Standley 4579.*

Sandia Mountains, New Mexico, Oct., 1883, *Bigelow,* probably belongs here.

11. DELPHINIUM COCKERELLII A. Nelson, Bot. Gaz. **42**: 51. 1906

Type locality: "Baldy Mts., Elizabethtown, N. M."

This seems to be a rather rare species, which occurs in the

* The type specimen is without fruit; the description of the follicles is drawn from a specimen collected by Townsend in the same locality in the summer of 1898.

higher mountains of southern Colorado and the northern part of New Mexico. The following specimens may be referred to the species:

Near Pagosa Peak, Colorado, Aug., 1899, 9,000 feet, *Baker 325*.

Headwaters of the Pecos River, Aug., 1905, *Mrs. W. H. Bartlett*.

Pecos River (*loc.*?), June 24, 1898, *Herrick 15*.

Upper Pecos River, Aug. 3, 1898, *Maltby & Coghill 133*.

Pecos Baldy, Aug. 12, 1903, *Vernon Bailey 596*. U. S. Nat. Herb., sheet *no. 443,707*.

Pecos Baldy, July 11, 1908, 12,000 feet, *Standley 4301*.

12. **Delphinium macrophyllum** sp. nov.

Stems erect, from a woody (?) root, 7 to 15 dm. high, the largest 1 cm. in diameter at the base, glabrous almost to the inflorescence, striate; leaves on petioles which are slightly dilated at the base and 15 cm. or less in length, blades circular to pentagonal in outline, the lowermost 15 to 20 cm. in diameter, apparently 5- to 7-lobed, in reality palmately divided to the base into three parts, the lateral divisions again parted two thirds to three fourths of the way down into two, sometimes three lobes, principal segments rhombic in outline, 6 to 12 cm. long, from one third to one half as wide, with numerous coarse acute teeth, the uppermost leaves gradually growing smaller with narrower and fewer toothed segments, even the lowermost leaves finely pubescent on the veins, the uppermost pubescent on both surfaces; inflorescence a branching panicle (on oldest plants) or a simple raceme 15 to 40 cm. long, pedicels ascending, 1–2 cm. long, slightly elongated in fruit, bracts 5–8 mm. long, attached at the bases of the pedicels, floral bracts smaller and attached to the enlarged receptacles, all parts of the inflorescence and the young follicles pubescent with short hairs, more or less glandular; flowers of medium size, about 2 cm. long, deep blue; spur a little longer than the elliptic-ovate obtuse sepals, rather thick-conical, obtuse, slightly curved, horizontal or ascending; upper petals minutely 2-toothed at the apex, lower petals blue, limb 2-parted half way to the base, lobes ovate-lanceolate, erose; corolla with two small saccate outgrowths at the base of the limb, which is almost at right angles to the claw, another small saccate projection at the base of the claw; young follicles 3, erect, mature fruit not seen.

The type is Metcalfe's *no. 1311* collected on Hillsboro Peak

of the Black Range, Sierra Co., New Mexico, Sept. 11, 1904, on shady north slopes, altitude about 3000 m.

This plant seems to agree pretty well with the description of *D. cucullatum* A. Nels. but differs in at least two particulars. The sepals are deep blue instead of "greenish white or blue tinged" and they are not hooded. It is no doubt a segregate from *D. occidentale* Wats. but is very slightly if at all viscid-pubescent and the sepals are not acute.

Metcalfe's *no. 280*, collected on Mogollon Creek, in the Mogollon Mts., July 20, 1903, probably belongs here, though the leaves of this plant are smaller and have narrower segments.

NEW MEXICO COLLEGE OF AGRICULTURE AND MECHANIC ARTS,
AGRICULTURAL COLLEGE, NEW MEXICO.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1909)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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Vol. 37 No 2

BULLETIN

OF THE

TORREY BOTANICAL CLUB

FEBRUARY, 1910

The ferns and flowering plants of Nantucket—VI

EUGENE P. BICKNELL

CHENOPODIACEAE

CHENOPODIUM ALBUM L.

A common weed of waste places, cultivated fields, and sandy shores, displaying several pronounced phases of variation; begins to flower in July.

A pale and narrow-leaved littoral form is sometimes suggestive of *Chenopodium leptophyllum* Nutt. Another form often found along shores, growing in pure sand, has early deciduous leaves and, in September, its leafless stem and even the crowded panicles often become highly colored with deep reddish purple.

* CHENOPODIUM PAGANUM Reich. Fl. Germ. 579. 1830.

C. viride L. Sp. Pl. 219, in part—probably.

C. album, var. *viridescens* St. Am. Fl. Agen. 105. 1821.

Frequent. This is a common companion of *C. album*, distinguished from it by its bright or deep green color and almost non-farinose character. It appears not to have received any attention in this country as a different plant from true *C. album* but has long been definitely recognized by many European botanists under one or another name, often being erroneously referred to *C. viride*. It is well described by Reichenbach, De Candolle, Saint Amans, Moquin-Tandon, and other authors. Although closely related to *C. album* it presents a number of marked and fairly constant differences which are strikingly obvious upon comparison of the living plants. In addition to its bright green color

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and general absence of mealiness, it is characterized by thinner and larger, very long-petioled primary leaves, sometimes over 5 cm. wide, which are more broadly cuneate at base and usually more irregularly and acutely sinuate-toothed, and even aristulate-acute; a larger fruiting calyx with more sharply and abruptly carinate sepals; a somewhat larger utricle, flatter and rather more abruptly contracted around the edge to a blunter margin and usually darker and more distinctly rugulose-pitted. This plant often becomes coarser and taller and more widely branched than *C. album* and its flowering period appears to be somewhat later.

* CHENOPODIUM LANCEOLATUM Muhl.

C. viride L. in part.

Occasional or frequent, especially along shores.

This plant is nearer to *C. paganum* than to *C. album* but in its typical form is widely different in appearance from either. It varies from bright green with little or no mealiness to paler green and somewhat scurfy-farinose. It is often low and diffuse and slenderly much branched, the inflorescence consisting of scattered glomerules on very delicate or even thread-form flexuous branchlets, the leaves lanceolate to linear-lanceolate and entire or subentire, the uppermost reduced to narrowly linear bracts subtending many of the glomerules.

The citations underlying the *Chenopodium viride* of Linnaeus make it appear that his species was made up of three distinct factors. One of these was probably the plant later described by Reichenbach as *C. paganum;* another seems more certainly to have been the plant proposed over half a century later by Muhlenberg as *C. lanceolatum.* The remaining citation alone refers to a published plate and may therefore be taken as fixing the type of the species. This plate represents the European plant known as *C. opulifolium* of Schrader and, indeed, formed the basis of that species.

* CHENOPODIUM MURALE L.

Occasional or frequent in waste places in or near the town; Madequet; Siasconset. When growing in dry, sandy soil it is sometimes much reduced in size, with small somewhat fleshy leaves abruptly narrowed to the petiole, and contracted panicles;

in richer soil and more shaded situations it becomes much larger and brighter green, with thinner, acutely cut-sinuate leaves, narrowed to a slender petiole, and with larger looser panicles. Flowers from July and early August.

CHENOPODIUM HYBRIDUM L.

Siasconset, Sept., 1899 — a few large plants in waste ground; not observed since. Mentioned in Mrs. Owen's catalogue as having been seen once in waste ground in the town.

CHENOPODIUM RUBRUM L.

Shores of Sachacha Pond, in full flower and fruit Sept. 16, 1899; sparingly at Miacomet Pond; abundant on Coskaty in sand along the ocean shore, where it was in full flower Aug. 14, 1906.

* CHENOPODIUM AMBROSIOIDES L.

Street-sides and waste places about town and in neglected barnyards in the suburbs; apparently spreading; by a barn on Great Neck, 1904; farm yard in Polpis, 1906. It was frequent in the town streets as far back as 1899. Flowering from July and early August.

Note. — *Chenopodium Botrys* L. is included in Mrs. Owen's catalogue, although *C. ambrosioides* is not mentioned.

ATRIPLEX HASTATA L.

Common along shores and brackish marshes. It displays much variation, narrower-leaved states appearing to approach *A. patula* L. A pronounced form, found near the shore of Long Pond and elsewhere, almost concealed among taller surrounding plants, was bright green and nearly prostrate with wide-spreading flatly interlaced branches and very large lower leaves becoming 14 cm. wide. Flowers through August and September. Earliest leaves beginning to appear May 30, 1909.

ATRIPLEX ARENARIA L.

A characteristic plant of the sea-beaches, flowering through August and September.

SALICORNIA EUROPEA L.

Common on salt marshes and mud flats throughout. It is especially abundant on brackish marshes at the south shore, where,

in autumns favorable to its highest color development, it forms extensive reaches of vivid scarlet. At the middle of June the seedling plants are only 2–5 cm. high. In August and September it is in full flower. Anthers appearing sessile, 0.5 mm. long.

SALICORNIA BIGELOVII Torr.

Abundant on Coatue; rather common about Polpis Harbor; local at the western end of the island and along the harbor shore; flowering in August and September. Anthers appearing sessile, twice the size of those of *S. europea*. In late autumn it turns deep purple-red or claret color.

SALICORNIA AMBIGUA Michx.

Abundant on wet sand on Coatue, and occurring locally at all points where *S. Bigelovii* was found. Plant well developed by the middle of June, flowering in August and September. Anthers 1 mm. or more long on distinctly exserted filaments. In late autumn this species turns light yellowish or brownish red.

DONDIA LINEARIS (Ell.) Millsp.

Occurs rather sparingly along shores and the borders of salt marshes, flowering in August and September; along the harbor; Bache's Harbor; Coatue; western end of the island.

On Marthas Vineyard, where this species is very common, I have collected a form (it may occur on Nantucket also) which answers perfectly to the description of *Suaeda americana* (Pers.) Fernald, as interpreted by Fernald in Rhodora 9: 146. Au 1907. From observations made in the field in September and October I was unable to convince myself that this form was anything more than a state assumed by the common plant when more or less subject to tidal submersion. Its prostrate or semi-prostrate habit appeared to be the result of a heavier and more fleshy development under strongly saline influence.

* DONDIA MARITIMA (L.) Druce.

Perhaps rather more common than *D. linearis* and often found with or near it, but usually in wetter places, flowering at the same seasons.

SALSOLA KALI L.

Common on sea-beaches, flowering in August and September. The seedling plants begin to appear early in June.

* SALSOLA CAROLINIANA Walter.

Sparingly along the ocean side of Sachacha Pond and on the adjoining sea-beach.

AMARANTHACEAE

AMARANTHUS RETROFLEXUS L.

Less common than the next; August, September.

* AMARANTHUS HYBRIDUS L.

A common weed of cultivated fields and waste places; August, September. Either coarse and erect, or more slender and depressed with fewer and more elongated spikes. A single plant seen with purplish-tinged panicle.

AMARANTHUS GRAECIZANS L.

A common weed, sometimes abundant in cultivated fields flowering through summer and autumn.

* AMARANTHUS BLITOIDES S. Wats.

Sparingly along the railroad on Washington Street, 1899 to 1907; farm yard in Polpis, 1906; in full flower August and September.

AMARANTHUS PUMILUS Raf.

"On the beach. S. T. Olney, 1849." (M. L. Owen, Cat. 50.) The range of this species is commonly given as extending no further east than Rhode Island, yet Olney's record is explicit and I know of no reason why it should not be accepted as authentic, especially in the case of so unmistakable a plant. Nor is this the only record of the occurrence of the species in Massachusetts. In Hovey's Magazine (**13**: 219. 1847), it is mentioned by William Oakes as having been found at Gay Head, Marthas Vineyard, in 1829.

PHYTOLACCACEAE

PHYTOLACCA DECANDRA L.

Occasional in waste places near the town and in burned-over spots in the pine scrub; Quaise; Wauwinet. In full flower and fruit September 4, 1904.

AIZOACEAE

Mollugo verticillata L.

Very common, especially so on sandy levels about some of the south shore ponds. In full flower in August and September. Nothing was seen of it in June although in the same latitude it commonly begins to flower before the end of May.

PORTULACACEAE

Portulaca oleracea L.

Frequent in cultivated fields and occasionally elsewhere; apparently nowhere common. Noticed in flower as late as September.

* Portulaca grandiflora Hooker.

Along a neglected roadway at Siasconset in September, 1899, in full flower; not observed since.

ILLECEBRACEAE

Scleranthus annuus L.

Abundant in sterile soil, doubtless flowering at all seasons.

CARYOPHYLLACEAE

Agrostemma Githago L.

Apparently uncommon. Mrs. Owen mentions it as seen occasionally in fields. I observed it only once, on June 9, 1908, not yet in flower-bud. In midsummer its conspicuous flowers might well show it to be more common.

Silene vulgaris (Moench) Garcke.

Observed at four places, by street-sides and in waste spots in the town, and also in an old field on the Benjamin Coffin farm. In fresh flower June 9, 1908; still in bloom Sept. 10, 1904.

* Silene antirrhina L.

A scattered group of very small plants on a bank near Acquidness Point, June 2, 1909, the flower buds just appearing.

Silene Armeria L.

An occasional garden escape into waste ground, not observed, however, since August, 1906.

* SILENE DICHOTOMA Ehrh.

I failed to meet with this species but have seen specimens collected on Nantucket as follows: "Sandy meadow lot, Aug. 13, 1897," *T. N. Vasey*, and "Nantucket Sept. 2, 1896," ex herb. E. & C. E. Faxon, in herb. N. Y. Botanical Garden; "Maxcy's Pond, Aug., 1895," *Mrs. M. P. Robinson*, in herb. Nantucket Maria Mitchell Association.

LYCHNIS ALBA Mill.

Infrequent. Sparingly in a grain field west of the town June 6, 1909, in full flower and with large capsules; one station at Wauwinet, June 11, 1909, just in bloom; still in flower Sept. 18, 1907, in a grassy lot on Lily Street.

* LYCHNIS DIOICA L.

Occasional by street-sides and in hay and clover fields near the town; Shawkemo. First flowers June 2, 1909; still in full bloom Sept. 11, 1904, and Sept. 18, 1907.

SAPONARIA OFFICINALIS L.

Roadsides and waste places, common in the town and suburbs. In full flower August and September, the flowers often double.

DIANTHUS ARMERIA L.

Scarce. Two sheets are in the herbarium of the Nantucket Maria Mitchell Association, one from "grassy field back of 'the Cliff,' Aug. 15, 1891," one collected in a field on the Madequet road, Aug. 20, 1891, by Mrs. Nellie F. Flynn. I observed it only on Grove Lane, a few plants not yet in flower, June 17, 1908. Mrs. Owen has recorded it from Siasconset.

ALSINE MEDIA L.

Abundant and doubtless to be found in flower at all seasons.

* ALSINE GRAMINEA (L.) Britton.

A few plants in a low pasture near Monomoy in full flower June 7, 1908.

CERASTIUM VULGATUM L.

Everywhere in grassy places. In full flower May 30, 1909, but many plants only just in bud; mostly out of bloom by August, although occasional flowers may be found in September.

* CERASTIUM SEMIDECANDRUM L.

Common in and near the town in sandy fields and lots and along roadsides; abundant all over the sandy level by the hotel at Wauwinet, June 11, 1909; near Miacomet Pond. In full flower and fruit May 30, 1909, evidently blooming much earlier than *C. vulgatum*. The two species are frequently found together and when thus seen side by side the differences between them are strikingly apparent. *C. semidecandrum* is decidedly the more viscid-pubescent and particles of sand and other foreign substances often adhere thickly to its viscid cymes.

CERASTIUM ARVENSE L.

A characteristic plant of the island growing everywhere in sandy fields, on dry banks and along roadsides. In May and early June it is conspicuous from the abundance of its pure white flowers; by August it is mostly dried up and little noticeable. In full flower May 30, 1909; passing out of bloom June 7, 1908, and no flowers seen after June 15.

SAGINA PROCUMBENS L.

Frequent, and widely scattered over the island. Often found growing in the crevices of brick sidewalks in the town and common on damp levels by some of the ponds on the south shore; Surfside; head of Tom Never's Swamp; Siasconset; near Hummock Pond.

Sometimes growing in contracted tufts in pure white sand. In full flower from May to September.

ARENARIA SERPYLLIFOLIA L.

Common, usually in poor or sandy soil in dry places. In full flower May 30, 1909, mostly dried up by mid-August.

MOEHRINGIA LATERIFLORA (L.) Fenzl.

Common or, locally, even abundant in or about thickets on the eastern side of the island through Shimmo, Shawkemo, Quaise, and Polpis, to Pocomo and Squam; Tom Never's Swamp; Coskaty; among the cedars on Coatue. Just in flower June 2, 1909; mostly dried up by the middle of August.

Ammodenia maritima (Raf.) comb. nov.

Adenarium maritimum Raf. New Fl. N. Am. **1**: 62. 1836.

Arenaria peploides L., var. *robusta* Fernald, Rhodora **11**: 114. 1909.

On the coast sands all around the island, sometimes massed in great abundance along or among the dunes near the shore. Just in flower June 7, 1909.

SPERGULA ARVENSIS L.

In cultivated fields and along roadsides; common and widely spread. First flowers June 3, 1909; continuing to bloom through September.

* TISSA CANADENSIS (Pers.) Britton.

Observed only on Coatue; in full flower and fruit Sept. 7, 1904. Plants small, often forming compactly much branched tufts 6–16 cm. in diameter; sepals obtuse or rounded at apex, about half the length of the oblong-ovoid obtuse capsule; seeds 1 mm. in diameter, dark brown, wingless, roughened with minute points. Agrees closely with typical examples of *Tissa canadensis* from much further north except that it is not wholly smooth but more or less finely glandular-pubescent, at least in its upper parts. I met with the same plant, in October, 1909, on Chappaquiddick Island, Marthas Vineyard, the most southern point, I think, except Nantucket, from which it has been reported.

TISSA MARINA (L.) Britton.

Common on salt marshes and brackish shores; observed in flower from early June until late September.

Plants larger throughout than those of *Tissa canadensis* and more widely branched, sometimes spreading over 4 dm., more pubescent and with longer leaves and internodes and larger more acute sepals and capsule, the latter little exserted; seeds smooth, only half the size of those of *T. canadensis*, 0.5 mm. in diameter, and paler in color. No winged seeds were found in any Nantucket specimen.

TISSA RUBRA (L.) Britton.

Common in dry sandy places, often in waste ground. Observed in flower from May until late September.

NYMPHAEACEAE

BRASENIA SCHREBERI Gmel.

In a number of ponds and pools mainly on the eastern side of the island.

Nymphaea advena Ait.

Mrs. Owen's catalogue reports the spatterdock as not uncommon. I saw nothing of it nor did I succeed by inquiry among the islanders in ascertaining where it grew or had once grown. Since then, however, a letter from Mrs. Mary A. Albertson, Curator of the Nantucket Maria Mitchell Association, has informed me that it has been found by Miss Grace B. Gardner and by Mr. Walter Burdick in a little cove at the east end of Sachacha Pond.

Castalia odorata (Ait.) Woodville & Wood.

Common. Just in bloom June 17, 1908; observed still in flower as late as the middle of September.

A colony of pond lilies bearing large bright pink flowers was found in Squam, Aug. 13, 1906, in a small deep pool almost hidden by surrounding shrubbery. The locality is in an uninhabited part of the island and the plants had every appearance of being native, but I have been informed by Mrs. Albertson that the pink pond lily is known to have been planted somewhere in that section of the island.

CERATOPHYLLACEAE

Ceratophyllum demersum L.

Abundant in Long, Hummock, and Miacomet ponds; Washing Pond. Not observed in flower or fruit.

RANUNCULACEAE

Coptis trifolia (L.) Salisb.

The goldthread is included without comment in Mrs. Owen's catalogue. When on Nantucket I was not able to learn anything of the status of the species as an island plant and concluded that if it should possibly occur at the present day it must be extremely rare. I have since heard from Mrs. Albertson that she had recently been told by Miss Grace B. Gardner that it had been found by her in the "thorn lot." The reference is to the tract of land west of the town bordered by cockspur thorn trees which, Mrs. Owen has told us, were set out as a hedge about the year 1830.

* ACTAEA RUBRA (Ait.) Willd.

This woodland species occurs along Rattlesnake Bank, where, in favorable seasons, it forms patches of luxuriant growth and fruits prolifically; a small colony was found also in a dense thicket in Quaise and a single sterile plant in Polpis. Bearing green fruit June 11, 1909; fruit matured Aug. 7, 1906.

* AQUILEGIA CANADENSIS L.

Discovered in full flower June 2, 1909, near Acquidness Point, growing on a prominent knoll near the shore under a close thickety growth, mainly of bear oak, beach plum, and wild thorn (*Crataegus*). The colony consisted of perhaps thirty plants scattered over a space of about ten yards by three yards in general area. As this bright-flowered plant has never been reported from Nantucket it seems probable that it occurs at no other place on the island and, since the thicket which protects it is wholly isolated and almost surrounded by salt marshes, there is little chance of its ever being able to spread elsewhere.

ANEMONE QUINQUEFOLIA L.

Common in thickets and open low grounds. In full flower June 1, 1909; a few flowers remaining June 9.

* RANUNCULUS DELPHINIFOLIUS Torr.

In Squam, near Wauwinet, Sept. 5, 1904, — a nearly dried-out pot-hole covered with a dense tangle of leafy runners, no flowers remaining; a few plants in a similar situation about half a mile distant; some young plants in a muddy pot-hole near Tristram Coffin's Homestead, Sept. 12, 1907.

RANUNCULUS OBTUSIUSCULUS Raf.

In two small pools near the Orange Street railroad crossing, where it was long ago discovered by Judge J. R. Churchill and Mr. Walter Deane; also in a pool east of the Creeks. First leaves appearing May 30, 1909; in full flower in August and some flowers remaining at the middle of September.

RANUNCULUS ACRIS L.

Abundant, conspicuously so when in full flower in the fields and meadows in and near the town. Generally in flower May 30, 1909, but not yet at its height of bloom; few or no flowers left by the second week in September.

The later leaves, as well as those which are produced by a second growth following the mowing of the fields or other injury, are usually less deeply and narrowly cleft than those of the spring and early summer and have broader segments [var. *Steveni* (Andrz.) Lange]. This is the common state of the plant in the autumn, but, in its extreme form, is scarcely to be found in the spring, when the typical state of the plant prevails.

RANUNCULUS BULBOSUS L.

Common throughout, preferring a drier, poorer soil than *R. acris*, and much less noticeable in the late summer and autumn, the branching parts appearing to wither earlier in the season. In full flower May 30, 1909; no flowers remaining by September.

RANUNCULUS REPENS L.

In luxuriant abundance everywhere in low meadows and springy places in the neighborhood of the town and often growing about yards and along street-sides; sometimes in out of the way bogs. In full flower May 30, 1909; a few flowers may be found as late as the middle of September.

OXYGRAPHIS CYMBALARIA (Pursh) Prantl.

Common on damp sandy levels about some of the south shore ponds; Capaum Pond; salt marshes along the Creeks; Polpis Harbor. First flowers June 8, 1909; some flowers as late as the middle of September.

* THALICTRUM REVOLUTUM DC.

Rattlesnake Bank, not abundant, but growing with great vigor, some plants becoming nearly eight feet tall; Watt's Run Bank; thicket by shore pond east of Pocomo Head. Panicles well developed but not yet in flower June 11, 1908; well fruited Aug. 7, 1906.

THALICTRUM POLYGAMUM Muhl.

Mrs. Owen's catalogue records, on the authority of Mr. Dame, "a few depauperate specimens in swamps in Squam."

Note.— The barberry (*Berberis vulgaris* L.) is admitted to Mrs. Owen's catalogue upon the occurrence of a single plant found by Mr. Dame by the roadside near Siasconset. This was doubtless only a transient waif.

The Japanese *Berberis Thunbergii* DC. was twice observed in waste places near the town.

LAURACEAE

SASSAFRAS SASSAFRAS (L.) Karst.

Common in thickets, sometimes flowering when only three to four feet high. It is not often seen over ten feet in height, the largest trees occurring in Polpis and on Coskaty. First flowers June 4, 1909.

PAPAVERACEAE

CHELIDONIUM MAJUS L.

Almost confined to the town where it is common as a street-side and garden weed; occasional in waste ground at outlying points. In full flower May 30, 1909; in some seasons flowers are to be found up to the middle of September.

CRUCIFERAE

* LEPIDIUM CAMPESTRE (L.) R. Br.

A recently introduced weed first observed in 1908 — a single plant by the wharves and a small group in a farm yard west of head of Hummock Pond; in flower and fruit June 10. In June of the following year two plants were seen on the wharves and a single plant by a roadside in Polpis.

LEPIDIUM VIRGINICUM L.

A very common weed, sometimes flowering casually before the middle of June, but not generally in bloom until later in the month. Forms occur with densely pubescent leaves, others with the lower leaves pinnate with pinnatifid segments, these variations answering to the characters adduced for the so-called varieties *pubescens* Schmitz and *pinnatifidum* Schultz.

* LEPIDIUM DENSIFLORUM Schrad.

L. intermedium A. Gray. Not A. Rich.

L. apetalum Asch. and auct. Am. Not Willd. *fide* Thellung.

Apparently of only recent appearance on Nantucket; first observed in September, 1904 — two street-side plants in the town and a small group in waste ground at Siasconset. It was not seen at all in 1906 and 1907. In June, 1908, it was noticed once in

the town and also along a sandy driveway above the cliff. In 1909 it was seen at several places and at as remote a point as the life-saving station near the southwestern end of the island.

Specimens collected at Shimmo Valley farm June 2, 1909, too young for satisfactory determination, but doubtless referable to this species, are noteworthy. They are unusually foliaceous, with the rosulate basal leaves pinnate or deeply pinnatifid with laciniate-dentate segments; the flowers are distinctly petaliferous, the petals varying from rudimentary to 1.5 mm. in length.

* LEPIDIUM NEGLECTUM Thell. (?)

While I think that there can be no doubt about the occurrence of this species on Nantucket, the interrogation mark is employed because the specimens collected are too immature for positive identification. They grew in waste ground at Shimmo Valley farm June 2, 1909, in flower and early fruit.

The plant itself, although common enough in our eastern flora, has not yet made its way into our manuals, and thereby hangs a tale which may appropriately be narrated here. As far back as 1895 I collected in and near Van Cortlandt Park, New York, at three rather widely separated localities, a *Lepidium* which was clearly distinct from any of our eastern species then recognized. In that year Doctor B. L. Robinson had completed his study of the genus *Lepidium* for the Synoptical Flora of North America and I well remember discussing with him the Van Cortlandt specimens at the Columbia University herbarium in its old home in Hamilton Hall. The plant was determined by Doctor Robinson as *Lepidium medium* Greene and so recorded in Syn. Fl. N. Am. 1^1: 468, published in 1897. Subsequently, in 1898, I collected the same plant in Bronx Park, N. Y., and also on Mt. Desert, Maine, where a single specimen was found in a clearing near the woodland bicycle path. I noticed it also near Short Hills, New Jersey, in 1900, and of late years have found it to be rather well distributed in southwestern Long Island.

In the year 1899 Mr. Percy Wilson collected at random, he tells me, a number of specimens of *Lepidium* at Bedford Park, New York, near the entrance of the New York Botanical Garden. These were forwarded in an exchange of specimens to Doctor Albert Thellung, at Zurich, who, as it happened, was engaged on his

monograph of the genus *Lepidium*, which appeared in 1906. It developed that Mr. Wilson's collection included specimens of *L. virginicum* and of *L. densiflorum*, together with a new species which was described by Doctor Thellung as *Lepidium neglectum* (Bull. Herb. Boiss. II. 4: 708. 1904). This description makes it plain that the new species is precisely the Van Cortlandt Park *Lepidium* already referred to. Doctor Thellung had, in 1903, referred the plant, as had Doctor Robinson, to the *Lepidium medium* of Greene. Its relationship to this southwestern species is indeed close, but an examination of authentic specimens of *L. medium* does not allow me to doubt that Thellung was finally right in regarding the two plants as distinct.

Lepidium neglectum is so nearly intermediate between *L. virginicum* and *L. densiflorum* that the question of hybridization is readily suggested. Yet in the behavior of the plant and in its environments as I have observed it, no evidence has appeared, aside from the mere fact of association, that it is not a perfectly true species. The three plants sometimes occupy the same square yard of space, yet *L. neglectum* is also found growing with *L. virginicum* in localities where *L. densiflorum* is unknown.

Lepidium neglectum, although discussed by Thellung especially in its relation to *L. densiflorum* has much more the aspect of *L. virginicum*. It is, indeed, sometimes difficult to distinguish from forms of the latter except by reference to the position of the cotyledons in the seed, which is always conclusive — accumbent in *L. virginicum*, incumbent in *L. neglectum*. The most obvious differences from *L. virginicum* are more elongated racemes and shorter-pedicelled and often larger and more orbicular capsules, which become over 3 mm. long and broad; it differs also in the form and texture of the leaves and in the character of the obscure pubescence. In the field it may be useful to recall that it begins to flower considerably earlier than *L. virginicum*.

There need be no uncertainty as between *L. neglectum* and *L. densiflorum*. The former is at once set apart to the eye by its much larger and less crowded, more broadly orbicular capsules, and by its petals, which are always more or less obvious except in the terminal or later flowers, where they may be rudimentary or even absent.

* CORONOPUS DIDYMUS (L.) J. E. Smith.

In the collection of the Nantucket Maria Mitchell Association I found an unmounted fruiting specimen of this wart cress among a series of plants which, Mrs. Albertson informed me, had been collected in or near the town in August, 1908.

* THLASPI ARVENSE L.

Wauwinet, June 11, 1909, a small colony of scattered plants in a waste spot back of the beach, growing with *Brassica arvensis*, *Brassica campestris*, and *Conringia orientalis*. The plants were mostly just beginning to flower, but a few bore good-sized pods.

SISYMBRIUM LEIOCARPUM Jord.

A very common weed of farm yards, old fields, and waste ground. First flowers May 30, 1909.

Nothing was seen of typical *Sisymbrium officinale* (L.) Scop., which, although apparently rare in the eastern states, I have collected near New York City and on Long Island.

* SISYMBRIUM ALTISSIMUM L.

A recently introduced weed which threatens to become troublesome. First observed June 12, 1908, two plants just in flower in a field west of the town and a single plant in waste ground on the road to Surfside. The following year it was found in considerable abundance at Shimmo Valley farm and also in a cultivated field on the Miacomet Pond farm, just in flower June 2.

CAKILE EDENTULA (Bigelow) Hooker.

Common on sea-beaches. First leaves May 30, 1909; continuing to bear flowers into September.

BRASSICA CAMPESTRIS L.

Occasional in old fields and waste places. Back of the shore on the ocean front at Wauwinet it was freshly in flower June 9, 1909; the same day in a waste spot near the town it showed well-developed fruit. Plant pale green and glaucous, fleshy, glabrous, or the lowest leaves bearing obscure scattered hairs; flowers bright, light yellow, the petals about 1 cm. long.

* BRASSICA RAPA L.

Frequent in cultivated fields. Scattered plants in a wheat field near the town were freshly in flower June 13, 1909.

Plant greener and thinner-leaved than *B. campestris;* at leas the lower leaves, and often the base of the stem, hispid-pubescent flowers deeper yellow, rather small, the petals 7–8 mm. long.

* BRASSICA NAPUS L.

About farms and in old fields, sometimes common as a survival of cultivation; occasionally in grain fields. In full flower and with well-developed fruit June 12, 1909. Much stouter and taller than the other associated Brassicas, and very conspicuous when in full bloom. Wholly smooth, blue-glaucous and rather fleshy; flowers resembling those of *Brassica oleracea,* very pale yellow, large, the petals sometimes 18 mm. long.

* BRASSICA JUNCEA (L.) Cosson.

Occasional or frequent about the wharves and streets and in outlying old fields. First flowers June 2, 1909; no flowers observed as late as September.

BRASSICA NIGRA (L.) Koch.

Common about the wharves and fishermen's houses and in waste places, beginning to flower later than *B. juncea.* First flowers June 10, 1909; remaining in full flower through September.

* BRASSICA ARVENSIS (L.) Kuntze.

About farms and in old fields and waste places, now generally common but apparently infrequent until recent years. First flowers May 31, 1909; continuing to bloom into September.

* DIPLOTAXIS MURALIS (L.) DC.

Along a cartway in the western outskirts of the town Sept. 11, 1899, some flowers remaining. Not observed since. Plant exhaling an unpleasant odor, suggesting that of *Geranium Robertianum.*

RAPHANUS RAPHANISTRUM L.

Abundant in neglected and in cultivated fields. First flowers May 30, 1909; remaining in bloom through September.

* RAPHANUS SATIVUS L.

Met with several times near cultivated ground and in waste places. First flowers May 30, 1909; also in full flower at the middle of September.

BARBAREA RIVULARIS Martr. Pl. Crit. du Tarn. 1 : 9. 1862 ; Fl. Tarn. 44. 1864.

Barbarea stricta auct. Am. Not Andrz.

A plant of comparatively recent introduction to Nantucket and now fast becoming widely established. Mrs. Owen reports *Barbarea vulgaris* as having first appeared in 1883 ; this record probably refers to the species here discussed, which was not at that time generally recognized as distinct from *B. vulgaris.* In September, 1889, I observed two plants in a weedy alley in the town, but saw nothing more of it until June, 1908, when a few plants were observed near the old wharves and by a street-side in the town and a mass of it occupied a shallow gully in the side of the cliff. The next year it had spread extensively and was seen at a number of points in the town as well as in fields near by, and at such distant points as Miacomet Pond farm, Hummock Pond and the life-saving station at the southwestern side of the island. In full flower May 30, 1909.

* RADICULA NASTURTIUM-AQUATICUM (L.) Britten & Rendle.

Growing in luxuriant masses about springs and ditches at Shawaukemmo ; Watt's Run ; near Reed Pond. First flowers May 30, 1909.

* RADICULA PALUSTRIS (L.) Moench.

A group of half a dozen plants just in flower June 6, 1909, at edge of pool by the Madequet road, just beyond Crooked Lane.

* RADICULA ARMORACIA (L.) Robinson.

Frequent in and near the town ; ditch in Polpis. Just in flower May 30, 1909.

CARDAMINE PENNSYLVANICA Muhl.

Not common ; ditches west and southwest of the town ; Quaise ; Polpis ; Watt's Run. In full flower May 31, 1909.

Along Watt's Run, in the shade of a dense thicket, occurs a lax and slender form which so closely simulates *Cardamine flexuosa* With. that it required a close examination of the siliques and styles to convince me that it was not that species.

* CARDAMINE ARENICOLA Britton.

Wet meadow west of the town ; Shawkemo ; muddy border of sink-hole near Tristram Coffin's Homestead. In full flower May 31, 1909.

BURSA BURSA-PASTORIS (L.) Britton.

A common weed occurring in various more or less distinct forms or elementary species.

DRABA VERNA L.

Common in sandy fields and along roadsides in and near the town; Monomoy; Shawkemo. Plants past flowering and mostly dried up by May 30, 1909, but in protected spots still green and retaining mature fruit. On June 7, 1908, only withered plants were to be found, many retaining the dried septa of the pods.

* ERYSIMUM CHEIRANTHOIDES L.

Two plants in waste ground at Shimmo Valley farm, just in flower June 2, 1909.

* ALYSSUM ALYSSOIDES L.

Along a sandy bank and adjoining grassy level by an old stone foundation on the cliff. In full flower and fruit June 2, 1909. Petals at first yellow, early becoming pure white.

* CONRINGIA ORIENTALIS (L.) Dumort.

Wauwinet, June 11, 1909, two plants just in flower in waste spot back of the beach with *Thlaspi arvense*, *Brassica arvensis*, and *Brassica campestris*. Petals palest yellow or cream-colored.

Note. — *Hesperis matronalis* L. is occasionally found by streetsides in the town as a casual escape from adjoining gardens.

RESEDACEAE

RESEDA LUTEA L.

Reported by Mrs. Owen, on the authority of Mr. Dame, as being well established in a pasture in Polpis in August, 1886.

SARRACENIACEAE

SARRACENIA PURPUREA L.

Occurs in a few sphagnum bogs between Polpis and Sachacha. In one of the larger bogs it was numerous enough to be rather conspicuous when in full flower June 15, 1908.

DROSERACEAE

DROSERA ROTUNDIFOLIA L.

Common in sandy and peaty bogs.

DROSERA LONGIFOLIA L.

Common in bogs and on pond shores.

DROSERA FILIFORMIS Raf.

Common on the sandy shores of Tom Never's Pond and sparingly near the head of the swamp. A single flower as late as Sept. 15, 1907.

CRASSULACEAE

TILLAEASTRUM VAILLANTII (Willd.) Britton.

One of the rarer plants of which we have earliest record on Nantucket is the *Tillaea simplex* of Nuttall, which was recorded by William Oakes as having been collected by him in 1829 "on the dried borders of small ponds" (Hovey's Mag. **7**: 182. 1841). Writing in 1888, Mrs. Owen says "Not reported since." In the herbarium of the Nantucket Maria Mitchell Association and of the New York Botanical Garden are Nantucket specimens of the plant now referred to *Tillaeastrum Vaillantii* (Willd.) Britton which were collected by Mrs. Mabel P. Robinson on the shore of Hummock Pond Aug. 15, 1894, and July, 1896. Mrs. Albertson has informed me that the plant still grows at that locality, having been collected there in very recent years.

Whether *Tillaeastrum Vaillantii* (Willd.) Britton is really distinct from *Tillaeastrum aquaticum* (L.) Britton (*Tillaea simplex* Nutt.) cannot yet be said to be satisfactorily established. The only diagnostic character adduced for *T. Vaillantii* would seem to be the slender peduncle, but such a character might well prove to be an unstable one in a shore plant which is doubtless sometimes subject to submersion, and it remains to be determined whether the elongation of the peduncle is not related to a chance submersion of the plant during some period of its growth. In one of Mrs. Robinson's Nantucket specimens the lower flowers only are peduncled, the uppermost being subsessile.

Should the two plants be distinct, it is not improbable that both are to be credited to Nantucket and that Oakes was quite correct in his record of *Tillaea simplex*, which plant, in its perfectly typical form, was collected on Marthas Vineyard, not twenty miles from Nantucket, on September 27, 1909.

* SEDUM PURPUREUM Tausch.

Bank near the Orange Street railroad crossing; dry field over a mile west of the town. First observed June, 1908.

SEDUM ACRE L.

At two localities in dry fields near Millbrook Swamp; bank on Grove Lane; Poor House grounds and roadsides near by.

GROSSULARIACEAE

GROSSULARIA HIRTELLA (Michx.) Spach.

Thickets or open ground either in dry or moist soils, sometimes in open boggy places. In full bloom May 31, 1909, a few flowers as late as June 20; some fruit nearly full size June 7.

Not a few of the plants of Nantucket differ from the ordinary form of their species found on the mainland. The variations from their common types displayed by such species may be either slight and inconstant or well emphasized and firmly established. And there may be discerned a tendency in a number of species of widely different relationships to follow similar lines of variation, thus affording a hint of some broad influence operating in the flora of the island.

The reduced stature of arboreal species on a wind-swept island may be readily understood and is doubtless correlated with an increased horizontal growth of the branches and their development low on the trunk, or from its base, which is a frequent condition of Nantucket trees.

In the herbaceous species which show obvious departures from their usual forms it seems possible to recognize a drift of variation in two main directions, one towards an increased development of pubescence, the other leading to a tendency in certain erect or ascending species to become declined or even prostrate.

The Nantucket gooseberry is a marked example of a species modified by an unusual development of pubescence. In its extreme form the young branches, petioles, and lower leaf surfaces are densely white-tomentose and the upper surfaces of the leaves closely soft-pubescent. This increased pubescence often extends to the flowers, which become notably villous, and to the fruit, which is sometimes finely puberulent all over and may even de-

velop an occasional weak spine. In other more variable characters the plant is also noteworthy. The leaves are often smaller and thicker than in the typical form with the larger veins distinctly impressed above; they may also be duller green in color, less deeply cleft, less sharply dentate and with more obtuse lobes. Parts of the stem and branches are often densely bristly but, by the exfoliation of the pale outer bark, become bright reddish brown and wholly unarmed except for the infra-axillary spines.

This form of the plant is the prevailing one on Nantucket. The typical plant also occurs and each form appears to shade insensibly into the other.

Many specimens of the pubescent form are identical with typical material of *Ribes oxyacanthoides*, var. *calcicola* Fernald, from the Province of Quebec (Rhodora **7**: 153–155. Au 1905).

The development of air chambers in the Ricciaceae

PAULINE E. HIRSH

The thallus in the family Ricciaceae is characterized by the presence of clearly defined air spaces, varying in different species in size and shape. On the basis of the structure of the tissues and enclosed air chambers a subdivision of the old genus *Riccia* into smaller genera is made by some writers. For example, Evans and Nichols in their "Bryophytes of Connecticut" have placed in the genus *Riccia* those species with air spaces in the form of narrow canals lying between rows of cells at right angles to the upper surface of the thallus. Species with the green tissue arranged in layers one cell thick, separating irregular air spaces from one another, they placed in the genera *Ricciella* and *Ricciocarpus*, the latter characterized by an epidermis with pores, the former by an epidermis without pores, though sometimes becoming ruptured irregularly with age.

In the Botanical Gazette for September, 1907, Barnes and Land published a paper dealing with the origin of air chambers in the Marchantiales. They studied representatives of as many groups as they could obtain, and described results so uniform as to make it, in their opinion, a matter of doubt whether any other mode of origin exists than that found in every plant investigated. They concluded that the "air chambers of Marchantiales arise invariably by the splitting of internal cell walls, usually at the junction of the outermost and first internal layer of cells." * In the Ricciaceae they examined only *Riccia fluitans* and *R. natans*. They stated that in these species "the origin of the air chambers is exactly alike, though the later course of development seems to be different. The origin of both is certainly by internal cleavage, and it is quite evident that the air chamber is wholly unrelated to the sex-organ pit." †

At the time that the present study was undertaken, the only fresh material available was "*Riccia lutescens*," the terrestrial form

* Barnes and Land. Bot. Gaz. 44: 213. 1907.

† Barnes and Land. *L. c.* 205.

of *Ricciocarpus natans*, which was obtained from the marshes near the southern end of Cayuga Lake. In addition, material of *Riccia Frostii* Aust., which had been preserved in alcohol, was used.* For comparative purposes herbarium material of *Riccia nigrella*, *R. glauca*, *R. Miyakeana*. *R. crystallina*, *R. arvensis hirta*, *R. fluitans*, *R. Donnellii*, and *Ricciocarpus natans* was studied. This was prepared for sectioning by first soaking it in dilute KOH and warm water before running it through the alcohols and cedar oil, and imbedding finally in paraffin. Although the tissue of this herbarium material was distorted and could not be used as a basis for positive statements or drawings, it was evident that the first three species named presented a different type of air chamber from that found in the two species studied by Barnes and Land; and the earliest stages suggested an entirely different origin. *Riccia Frostii* Aust. also exhibited the same type of air chamber; and as this had been preserved in alcohol the tissue was in good condition, so that satisfactory sections through the apical region could be obtained and the development of the air chambers could be followed with certainty.

A study of *Ricciocarpus natans* showed that in every instance the air spaces arise through cleavage. The figures (1–3 inclusive),

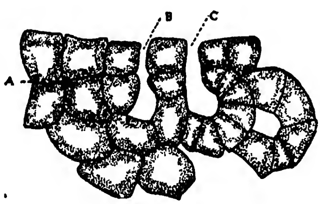

FIGURE 1. *Ricciocarpus natans.* Vertical longitudinal section of thallus near the growing point. *A*, early stage of an air chamber; *B* and *C*, older chambers which have opened to the outside.

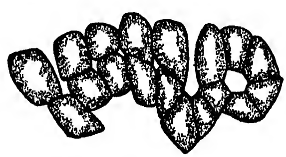

FIGURE 2. *Ricciocarpus natans.* Section nearly parallel to the surface showing origin of air chambers.

made from sections close to the growing point, display this clearly. There is no doubt concerning the origin of space A in FIGURE 1. B and C in the same figure show older spaces that have opened out to the surface FIGURE 3, A, indicates cell division preparatory

* The material was collected near the "Kaw River," Kansas, by an unknown collector. The writer is indebted to Professor Alexander W. Evans for its determination.

to the closing of the air chamber C that has broken out to the surface. All of the figures confirm the truth of the statements of Barnes and Land; and they cannot be interpreted in any other way than in consonance with their observations.

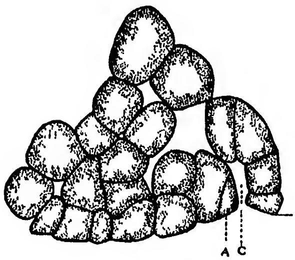

FIGURE 3. *Ricciocarpus natans.* *A*, cell division preparatory to closing the chamber *C*.

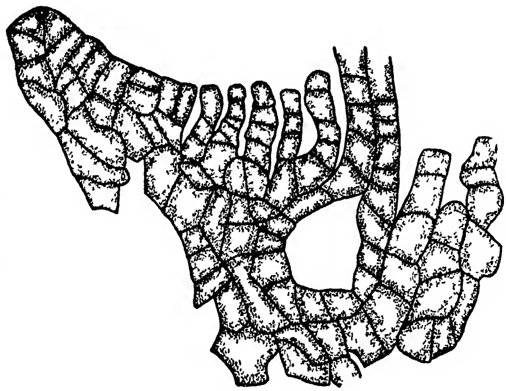

FIGURE 4. *Riccia Frostii.* Vertical longitudinal section, showing archegonium and origin of chambers and filaments.

An examination of *Riccia Frostii* Aust., however, indicates an entirely different structure. FIGURES 4, 5, and 6 present a condition strikingly in contrast with that shown in the previous figures of *Ricciocarpus natans.* In FIGURE 6, A is the apical cell; M is a young archegonium; B, C, and D, are tiny depressions lying between the rounded ends of the outermost layer of cells; N and O show older spaces, and at P is shown the way in which the elongated, narrow air spaces are closed at the end. The air chambers of *Riccia Frostii* Aust. are, therefore, narrow chambers or canals, which are the spaces between the elongated filaments or rows of cells at right angles to the upper surface of the thallus. FIGURE 6 shows clearly the way in which these filaments and spaces originate. Immediately back of the apical cell, the superficial cells arch outward in a papillate manner as a result of the cessation of growth at the lines of their junction. As they elongate they are divided by transverse walls so that filaments or rows of cells are formed, which are separate and distinct from one another. The intervening spaces in this species are formed, therefore, not by the cleavage or the separation of mature tissues, but in a manner

almost exactly indicated by the diagrammatic scheme given by Barnes and Land in their figure 1. During the formation of the filaments there is a marked growth in the thallus in which the protruding filaments do not share, so that the air spaces broaden per-

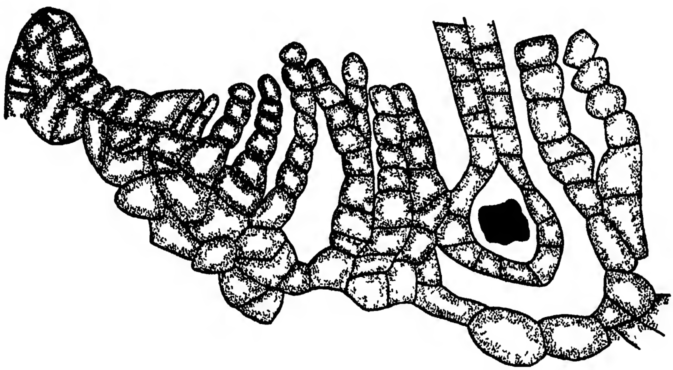

FIGURE 5. *Riccia Frostii.* Later stage, showing similar structures.

ceptibly. In the older parts of the thallus the air spaces may become nearly completely closed (FIGURE 6, P) through the enlargement of the terminal cells of the filaments; but, nevertheless, they retain their canalicular form and present an entirely different appearance from the irregular but more or less polygonal air spaces of *Ricciocarpus natans.*

This method of development is clearly in harmony with Leitgeb's account of the origin of intercellular spaces. In his "Untersuchungen über die Lebermoose" Leitgeb maintains that near the growing point on the dorsal surface there appear between four cells small pits that in profile view are simply dark points, "that these impressions arise not by cleavage but in this way, — that the free outer walls of the enclosing cells grow up over these places." B, C, and D in FIGURE 6 are without doubt these pits. He states further that there is a possibility that occasionally these depressions could elongate through a splitting from without in; but he rejects this in favor of the view that their increase in size is accomplished by a growth in thickness of the thallus dorsally.* He thus believed that the sex organs are visible at the same time as the pits that form the very beginning of the intercellular space formation, and that, as in the case of the former, the whole cell

* Leitgeb, Untersuchungen über die Lebermoose 4: 17, 27. 1879.

becomes imbedded by an upward growth of the surrounding tissue, so in the case of the latter the bottom of the pit becomes sunken in the thallus by similar growth.

From what has been said it is evident that there are two methods of origin of the air spaces in the Ricciaceae: the first, by

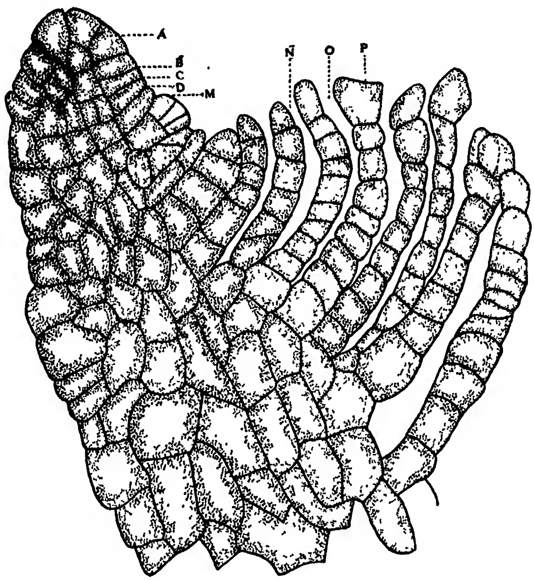

FIGURE 6. *Riccia Frostii.* *A*, apical cell; *M*, young archegonium; *B*, *C*, and *D*, tiny depressions formed by the beginning outgrowths of cells; *N* and *O*, older air chambers between filaments; *P*, terminal cell of filaments swollen until chambers are partly closed.

internal cleavage, resulting in the formation of broad, irregular, chamber-like spaces separated by plates of green cells one layer thick; the second by the upward growth of filaments at right angles to the surface of the thallus, resulting in the formation of elongated, narrow air chambers. The two species studied by Barnes and Land represent only *Ricciella* and *Ricciocarpus*, in which groups the origin of the air chamber is by internal cleavage. *R. Frostii* Aust., on the other hand, is a true *Riccia*, in which the air chambers are formed by the growth of filaments at right angles to the surface.

This work was done in the botanical laboratory of Cornell University at the suggestion and under the supervision of Dr. E. J. Durand.

The validity of Helianthus illinoensis Gleason as a species

Frank C. Gates

The plants to which the name *Helianthus illinoensis* Gleason was assigned were collected by Dr. H. A. Gleason on sand dunes along the Illinois River near Havana, Illinois, during 1903 and 1904, where they occur in the *Quercus velutina* association. The original description was published in the Ohio Naturalist (5: 214. 1904) and reprinted in "On the biology of the sand areas of Illinois" by C. A. Hart and H. A. Gleason (Bulletin Illinois State Laboratory of Natural History 7: 188. Ja 1907). The salient points in the description are as follows:

"Erect, six to ten dm. high, from a long running rootstock. Stem simple, slightly angled, densely villous below, pubescent above. Leaves six to eight pairs, strictly opposite, slightly scabrous above, softly pubescent beneath and villous on the veins, obtuse; the lowest four or five pairs oblong-lanceolate to ovate-lanceolate, three-nerved, entire, ten to fifteen cm. long, tapering at the base into a winged petiole equaling or but little shorter than the leaves; the upper two or three pairs much smaller or bract-like, petiole short or none. Lower internodes five to eight cm. in length, or the two lowest pairs of leaves approximate, upper internodes much longer. . . . Flowers in August. . . . *Helianthus illinoensis* is evidently closely related to *Helianthus occidentalis* Riddell, which it resembles in the reduction in size of the upper leaves. It is at once distinguished from the latter species by the villous pubescence and the greater length of the lower internodes. The two are sometimes associated in the field, but in general appearance they are entirely distinct. *Helianthus occidentalis* has broad, scabrous, light green, short-petioled leaves which are nearly erect in a basal cluster, while in *Helianthus illinoensis* they are darker green, more or less spreading and scattered on the stem."

The corresponding features of *Helianthus occidentalis* Riddell are thus characterized in Britton's Manual:

"Stems appressed-pubescent or sometimes nearly glabrous, slender, mostly simple, 6–9 dm. high. Leaves mainly basal, firm, ovate or oblong-lanceolate, obtuse or obtusish at the apex, narrowed at the base, 3–5-nerved, serrulate or entire, mostly scabrous above, pubescent beneath, with slender petioles."

In the American Naturalist (**42**: 73–80. F 1908), David Starr Jordan formulates what he terms the "Law of Geminate Species" in these words: "Given any species, in any region, the nearest related species is not to be found in the same region nor in a remote region, but in a neighboring district separated from the first by a barrier of some sort or at least by a belt of country, the breadth of which gives the effect of a barrier." This statement is given in slightly different words and amplified to make its application to plants more obvious by A. E. Ortmann (Science II. **27**: 427. 1908) as follows. "Closely allied species occupy neighboring areas; more or less closely allied species, occupying the same or nearly the same territory, generally possess different habits." This makes it clear that ecological as well as geographic segregation enters into the composition of species. Stated upon an ecological basis, this principle is that closely allied species ought not to occur within the same association in a given geographic area. Variations in any given species are always more or less marked according to local or edaphic factors. This variation, occasioned by environment, leads to extreme types between which there may be every gradation. In some cases only the extremes are noticeable but wider observation will reveal the intermediate steps. Ecological consideration of the factors involved clearly shows that these types are variations of one species. When variation in ecological factors has led to the production of two or more apparently well-characterized types, it is frequently necessary, for the sake of definiteness and conciseness in referring to them, to give them recognized names. These names, however, are not of really specific rank. In general, the normal type or the one from which the variations occur ought to bear the specific name and the well-characterized variations, especially those which are connected with the normal form by comparatively few gradations, ought to bear subspecific names, reserving the term "variety" to horticulture where it more properly belongs. Ortmann (Science II. **27**: 429. 1908) sums up the idea in the form of a rule. "If further studies should show that there is segregation, geographical or ecological, between these forms, then they are *species*; if not, they are *varieties* (= subspecies), which fact then also will be expressed in their morphological condition, one form running into the other at least in certain parts of their ranges."

As the plants under consideration were both found in the *Quercus velutina* association where it occurs on sand dunes, it seemed well to look into their status during 1908, when the sand areas of Illinois were studied by Dr. Gleason. During the early part of the summer, plants seemingly belonging to the new species were found associated with the *Quercus velutina* wherever that association occurred. The following are a number of localities in which this association was studied and from which plants in question were collected:

St. Anne, Kankakee Co., Ill. (*Gates 2437, 2439.*)
Hanover Station, Jo Daviess Co., Ill. (*2662, 2672.*)
Savanna, Carroll Co., Ill. (*2684.*)
Oregon, Ogle Co., Ill. (*2718, 2733.*)
Winthrop Harbor, Lake Co., Ill. (*2774.*)
Beach, Lake Co., Ill. (*2749, 2887, 2936, 2965.*)

In addition to these localities observations were made in Rock and Kenosha counties, Wisconsin, and McHenry Co., Illinois.

Nothing seemed to be amiss until near Winthrop Harbor, Illinois, it was discovered that plants which in the spring and early summer were *H. illinoensis*, were at the time of blooming and fruiting simply *H. occidentalis.* This observation led to careful study of these plants wherever they were found during the season of 1909. The conclusions that were inevitably drawn were that *H. illinoensis* was an ecological subspecies of *H. occidentalis*, provoked in response to severer xerophytic conditions or increased food supply. Accordingly I propose that these plants should bear the name:

Helianthus occidentalis illinoensis (Gleason) Gates, comb. nov.

Helianthus illinoensis Gleason, Ohio Nat. 5: 214. 1904.

Helianthus occidentalis grows both in the black soil prairies of Illinois, etc., and in the sand areas which are distributed over the north and central parts of Illinois. In so far as could be observed those plants of this species growing in the black soil prairies showed no indications whatsoever towards modification in the direction of the subspecies. The latter is a plant of sand regions, but the mere growing of the type in sand does not necessarily mean that any characters of the subspecies will appear. In all

situations this species grows erect from a long running rootstock, by means of which propagation is usually effected from year to year. Reproduction by seeds does not seem to be customary in view of the scarcity of seedlings observed. Observations on the association of the individual seedlings, in the Beach region at least, seemed to point to the dissemination — not of the seeds separately — but by heads containing the full quota of seeds or nearly so. At all events vegetative propagation and reproduction soon lead to the formation of a patch of plants. The patch is usually a closed association and admits of but few interstitials (such as *Polygonum tenue* or *Arabis lyrata*), while on the other hand the patch may spread outwards for a meter or more. It was this assemblage in patches that furnished the key to the situation. It was very plainly evident that edaphic factors varied within the extent of the patches. Of these the most important were light and soil. Another factor, water supply, due to varying amounts of precipitation, varied from season to season and also within a given season. These three factors, acting either singly or conjointly with the compound factor, wind, may produce the subspecific type, *H. occidentalis illinoensis* on sandy soil. In so far as could be determined, the greater amount of pubescence which is characteristic of the subspecies, *H. occidentalis illinoensis*, was to afford the plant adequate protection from excessive transpiration brought about by varying edaphic conditions. Light, acting singly while the other factors mentioned were constant, could produce the subspecific type, provided the physiological water-content of the soil was such as to make the transpiration ratio (*i. e.*, the amount of water transpired divided by the amount of water taken up by the plant) at or below the critical point for the particular plants. Some patches were found which extended from the full sunlight up into the fairly dense shade of oak trees and in every observed case those plants which received full sunlight were more pubescent than those in the shade.

It is, however, only in case the water supply is deficient that the difference in pubescence is so marked as to constitute the subspecific type. Long lower internodes are characteristic of the subspecies but several examples of plants growing in full sunlight with a dense villous pubescence had internodes but very little longer

than the normal type. It seems quite likely that this is due to the inhibiting action of excessive light upon plant growth. Typical plants of this species when growing on sandy soils normally occur in the shade. When growing in the sun on the black soil prairies of Illinois no deviation from the specific type was observed. In the case of the sand prairies of the Beach region the few cases that were found showed otherwise. In a few places where patches of this sunflower extended from the sandy soil into the edge of the prairie, whose soil, though essentially sandy, was gray on account of admixture with humus, the plants growing in the latter situation had the appearance of the subspecies while those that were in the purer sand remained characteristic of the species. It was very evident that both extremes had arisen from the same parent stock. This shows the tendency of an increased food supply to produce larger plants of the long internode type. The increased pubescence seems always to accompany the long internodes, while the latter may be virtually absent in cases where the former is present. Plants growing in sand mixed with humus under the shade of the oaks (*Quercus velutina*) generally responded with longer internodes. This was, of course, accentuated in the diminished light. The presence of the villous pubescence, which usually is regarded as a protection against excessive transpiration, is not so easy to understand, for the transpiration under the shade of the oaks is obviously not so great as in the open sunlight. As the soil is richer and there is no appreciable difference in the water supply, it may be that the hairs are produced from an excess of materials taken up into the plants, as is suggested by Strasburger for other more or less similar cases and for the grit cells of the pear.

The remaining factor that has the power to influence in the production of the subspecific type is the available water-content of the soil. A physiological water supply which is too low decreases the amount of water available for transpiration, consequently induces pubescence. Obvious excess of water supply was not observed and very likely seldom occurs, as water in the form of rain sinks rapidly through the sandy soil of the *Quercus velutina* ridges upon which this *Helianthus* grows. Normally a sufficient supply of the water is left in the sand as films around the sand grains. As is very well known, rainfall varies widely both from

season to season and even within a given season. This has a decided effect in the production of the subspecific type, as is shown in the following examples. The spring and the first part of the summer of 1908 were characterized by extreme and protracted drought in Illinois. During that time, almost without exception, plants of this sunflower were densely pubescent and had long internodes, whether they occurred in sun or in shade, in poor soil or in a richer soil. This is characteristic of *H. occidentalis illinoensis.* The drought was broken in August in Lake County, Illinois, and the result was that virtually all the plants, some of which had been definitely marked, lost their pubescence and to all intents and purposes were normal *H. occidentalis.* The season of 1909 had abundant precipitation throughout and during that entire year but very few plants were found that could be referred to *H. occidentalis illinoensis*, even in patches which the spring before had been dominated by that type.

Helianthus occidentalis easily maintains itself on the sand but it may also occur on black-soil prairies without apparent modification. In addition, it may occur on sand prairies where, near Winthrop Harbor at least, it is barely able to hold its own. In such situations, however, the plants are of the pubescent, long-internode type. The subspecific type, termed *H. occidentalis illinoensis*, always occurs in sandy soil, within or near the limits of the *Quercus velutina* association, where it is a response to edaphic conditions in the environment which increase the amount of food supply or which increase the transpiration on a soil more or less deficient with respect to either or both of the factors, physiological water supply and food materials.

The preceding conclusions have been based on field observation alone. Culture of the plants under control conditions will in the future give more conclusive results.

URBANA, ILLINOIS.

Notes on Rutaceae — III

Percy Wilson

Within the past few years, a number of writers on Rutaceae have taken up the name *Fagara* (L. Syst. ed. 10. 897. 1759) for the species of *Zanthoxylum* which have both sepals and petals. In his Species Plantarum (270. 1753), Linnaeus mentions only two species of *Zanthoxylum*, *Z. Clava-herculis* and *Z. trifoliatum*; the second is an *Acanthopanax* and belongs to the Araliaceae. *Z. Clava-herculis* is plainly the type of the genus *Zanthoxylum*.

In his Genera Plantarum (ed. 5. 130. 1754), the genus *Zanthoxylum* is credited to Colden and said to be without corolla, and it is evident that Linnaeus had in mind Colden's plant from New York, the species afterward described as *Z. americanum* Mill. In his Species Plantarum, however, Linnaeus did not refer to *Z. americanum*, but bases *Z. Clava-herculis* upon the extended description of *Zanthoxylum* in Hortus Cliffortianus and the description and plate of Catesby. The plant of the Hortus Cliffortianus and Catesby possessed a corolla and belongs in what has been called *Fagara*. *Fagara* then is a mere synonym of *Zanthoxylum* and the latter name should be retained for this genus of Rutaceae.

ZANTHOXYLUM (Catesby) L. Sp. Pl. 270. 1753

Zanthoxylum Hartii (Krug & Urban) P. Wilson, comb. nov.
Fagara Hartii Krug & Urban, Bot. Jahrb. **21**: 586. 1896.
Jamaica.

Zanthoxylum rhodoxylon (Urban) P. Wilson, comb. nov.
Fagara rhodoxylon Urban, Symb. Ant. **5**: 530. 1908.
Jamaica.

Zanthoxylum Liebmannianum (Engler) P. Wilson, comb. nov.
Fagara Liebmanniana Engler, Bot. Jahrb. **21**: beibl. 54: 20. 1896.
Mexico.

Zanthoxylum elegantissimum (Engler) P. Wilson, comb nov.
Fagara elegantissima Engler, E. & P. Nat. Pflanzenfam. **3**^{4}:

118. 1896. (Hyponym); Bot. Jahrb. **21**: beibl. 54: 25. 1896. Mexico.

Zanthoxylum mollissimum (Engler) P. Wilson, comb. nov.
Fagara mollissima Engler, Bot. Jahrb. **21**: beibl. 54: 22. 1896. Mexico.

Zanthoxylum bijugum (Engler) P. Wilson, comb nov.
Fagara bijuga Engler, Bot. Jahrb. **21**: beibl. 54: 23. 1896. Mexico.

Zanthoxylum monophyllum (Lam.) P. Wilson, comb. nov.
Fagara monophylla Lam. Tabl. Encycl. **1**: 334. 1791.
Santo Domingo to Trinidad, Costa Rica, and northern South America.

Zanthoxylum granulatum (Krug & Urban) P. Wilson, comb. nov.
Fagara granulata Krug & Urban, Bot. Jahrb. **21**: 594. 1896. Santo Domingo.

Zanthoxylum Harmsianum (Loes.) P. Wilson, comb. nov.
Fagara Harmsiana Loes. Bull. Herb. Boiss. II. **3**: 96. 1903. Guatemala.

Amyris Purpusii P. Wilson, sp. nov.

A small tree with grayish branches. Young twigs, branches of the inflorescence, and the petioles minutely hispidulous. Leaves opposite; leaflets 3, petioluled, elliptic to ovate, 2–3.8 cm. long, 1.2–2.4 cm. broad, coriaceous, rounded and somewhat emarginate at the apex; lustrous above, dull and minutely puberulous on the veins beneath, the margin entire or obsoletely crenate, lateral leaflets cordate at the base; inflorescence 3–5 cm. high; flowers not seen, sepals triangular, ciliate; drupe (immature) narrowly obovoid, 4–5 mm. long.

Type collected in Barranca de Santa Maria, Zacualpan, State of Vera Cruz, Mexico, *C. A. Purpus 2355*.

Related to *Amyris elemifera* L. and *A. balsamifera* L., but differing from both in the lateral leaflets, which are cordate at the base and rounded at the apex. The obovoid fruit and presence of hairs on the branches of the inflorescence seem to indicate that this species is closer to *A. balsamifera* L. than to *A. elemifera* L., which usually has a globose or subglobose fruit and the branches of the inflorescence glabrous.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1903-1909)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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Includes *Lopadiopsis floridana*, a new species from Florida, and two new species of *Buellia* and one of *Caloplaca* from Arizona.

Vol. 37 No 3

BULLETIN

OF THE

TORREY BOTANICAL CLUB

MARCH, 1910

The morphology of Taenioma

Elizabeth Ilsley Thompson

(WITH PLATES 9 AND 10)

The work here described was done in the Botanical Laboratory of Barnard College, Columbia University, under the direction of Professor H. M. Richards, for whose kindly interest and assistance, as well as that of Dr. T. E. Hazen, I wish to express my deep appreciation. I am greatly indebted also to Dr. M. A. Howe of the New York Botanical Garden, through whose kindness the material has been available for this work. The material used was collected by Dr. Howe on two of his southern trips and was preserved with the aid of formaldehyde as well as by drying. The fertile plants, possessing all the kinds of reproductive organs, were obtained in Porto Rico in 1903; sterile (rarely tetrasporic) plants were collected in the Bahamas (West Caicos) in 1907.

It is not the purpose here to determine the species to which these two plants belong. There are minor differences between them. The plant from Porto Rico (antheridial, cystocarpic, and tetrasporic) appears larger, is dark violet in color, less secundly branched, and the short flattened shoots are longer, sometimes 15–30 segments in length, are more closely and more conspicuously fasciculate or even fastigiate, and are prolonged into three hairs; while the plant from the Bahamas (sterile or rarely tetrasporic) is smaller, reddish purple in color, the branches are apparently more secund and the short flattened shoots, 9–15 segments in length, are prolonged into two hairs. In spite of these differences there seems little reason to doubt that both of these plants belong to the spe-

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cies *Taenioma macrourum* (Schousb.) Thuret.* According to Falkenberg ('01) the *Taenioma macrourum* which he found near Naples had short shoots ending in two hairs and but 15–20 segments long, which is somewhat longer than the specimen from the Bahamas; otherwise the two agree. The Bahamian plant also agrees with the *Taenioma macrourum*, as described originally by Thuret ('76) from plants collected by Schousboe in Tangier, as far as can be determined by the figures given and by the somewhat condensed description. Agardh ('63) alone notes that the flattened shoots are often prolonged into three hairs, but he is writing of *Taenioma per-*

* [EDITORIAL NOTE.—From a study of Thuret's description and figures of his *Taenioma macrourum*, based on Schousboe's plant from Tangier, Morocco (*Polysiphonia macroura* Schousb. in herb.), Miss Thompson seems to be justified in identifying at least the Bahamian plant with this species. But the question still remains as to the identity of this *T. macrourum* with the previously described *Taenioma perpusillum* of J. Agardh, based on material collected on the Pacific coast of Mexico. Thuret had not seen Agardh's specimen, but in proposing Schousboe's as a different species, he was influenced by the widely separated stations of the two plants, by some apparent differences in size and color, judging from Agardh's description, and by Agardh's alleged silence as to the apical division of the stichidium and the elongation of its divisions into two hyaline hairs. Agardh, however, does state that the stichidia are often excurrent at the apex "in fila minuta 3." I have had the opportunity of comparing Agardh's original specimen of *Taenioma perpusillum* (*Polysiphonia perpusilla* J. Ag. Öfv. Kongl. Vet.-Akad. Förh. 4: 16. 1847), in the Agardh herbarium at Lund, with my specimen from Porto Rico (Aguadilla, June 15, 1902, *no. 2433*) and find them essentially the same except that the terminal hairs are much longer and more luxuriant in the Porto Rican plant. In the original *T. perpusillum* the stichidia often terminate in three short hairs, as described by Agardh. My Bahamian specimens (West Caicos, December 20, 1907, *no. 5708*) differ in several respects from the Porto Rican, as indicated above by Miss Thompson. However, they are mostly sterile and they were found growing in an inland pond or lake, having, evidently, a subterranean communication with the sea — a place where several marine algae of recognizable species were more or less abnormal and peculiar. The color of these specimens when dry is reddish purple instead of the sordid green attributed to *T. macrourum* by Thuret and the terminal hairs (always, apparently, in twos) are commonly shorter than in the figures published by Bornet & Thuret and by Falkenberg, though often longer than any figured by Miss Thompson. In the Porto Rican specimens, the terminal hairs, which are nearly always in threes, though rarely in twos, are fully as long and as well developed as those figured by Bornet & Thuret and by Falkenberg for *T. macrourum*, though one, perhaps, might not infer this to be the fact from the figures drawn by Miss Thompson. The Porto Rican plants, by the way, were growing where they were well exposed to the surge of the open sea. From the evidence thus far available I am inclined to agree with Bornet (Mem. Soc. Nat. Sci. Cherbourg 28: 297. 1892), with Heydrich (Hedwigia 33: 295. 1894), and with De-Toni (Sylloge Algarum 4: 732. 1900) in considering *Taenioma macrourum* (Schousb.) Thuret a synonym of *Taenioma perpusillum* J. Ag. — M. A. H.]

pusillum J. Ag. and not of *T. macrourum* (Schousb.) Thuret. However, although it would seem probable that both of my specimens should be classed with *T. macrourum*, a discussion of the classification would not be profitable here, since this work concerns itself not with a determination of species, but with a description of the exact method of growth and cell division, and the appearance and formation of the reproductive organs.

The species of *Taenioma* studied is a small marine alga, forming dense tufts on other algae, or on sticks of wood near the low-water line. It is purplish red or dark violet in color, and minute in size as to the individual plants, though forming, in mass, patches easily distinguishable. The main axis is monopodial, siphonous, branched, creeping, segmented, and not corticated, and is attached to the substratum by numerous rhizoids (FIG. 1). Branches arising from the main stem are in turn much branched, frequently forming long secondary axes, which are prostrate and produce rhizoids. The shorter secondary axes are erect, arising alternately from either side of the stem, those on the lower side twisting in the process of erection, so that superficially they appear secund. Both these and the main shoot bear short flattened shoots, arising alternately, and prolonged at the apex into two or three long monosiphonous hairs. Growth takes place by means of a single apical cell which is recorded by Agardh ('63) as dividing dichotomously. Since the cell does not divide by a longitudinal split, as will be shown later, and since the main axis is monopodial, this cannot be considered true dichotomy, although the branching may be called subdichotomous.

The rhizoids are numerous, arising irregularly, each being a direct prolongation of any pericentral cell on the under side of the thallus. They are unicellular, often of considerable length, with ends rounded or spread out into disks or forked projections (FIG. 2).

The main stem or primary monopodial axis of the plant is composed of four pericentral siphons in protoplasmic connection with each other and with the central siphon. This latter forms a distinct core through the stem, the cells being elongated and closely joined, with deep pit connections. A stem segment is cylindrical, composed of four of these pericentral cells with the corresponding axial cell. No evidence of cortication has been

observed at the joints, even in the oldest portions. The method of growth is by a single dome-shaped apical cell, which cuts off disk-shaped cells at its base, each of which will correspond to a single segment in the fully formed stem. When the formation of a branch is to take place, the apical cell divides by an oblique wall into two unequal parts. The smaller of the two is the cell which will continue the main axis; the larger increases laterally and divides by an oblique wall at right angles to the first. This second dome-shaped apical cell forms the apical cell of a secondary axis (FIG. 4). Hence it is evident that this branching is not true dichotomy, since the two newly formed apical cells are not the product of the single division of an apical cell. The cell of the shoot tip is the true apical cell, for the branch apical cell is formed secondarily by the further growth and division in a cell underlying the tip cell. The apical cell of the tip next cuts off 3–6 disk-shaped segments below, in which soon appear two longitudinal divisions, separating these segments into three cells in a row in one plane.* Somewhat later and usually just behind the first branch formed from the tip, two other longitudinal divisions, parallel to each other and perpendicular to the first division, occur in the middle cell, forming the other two pericentral cells. Consequently in the fully formed stem the branches are separated by three to six segments, whose structure superficially resembles that of a simple *Polysiphonia* (FIG. 3).

The secondary axes develop in the same way as the main shoot, from the apical cell mentioned above. They may be short and erect with but 2–6 branches (FIG. 1), or they may be long and recumbent, giving rise to similar tertiary axes. On them as lateral outgrowths appear the flat short branches, and also the reproductive organs, the stichidia with tetraspores, the antheridia, and the cystocarps.

The flat shoots (FIG. 11) arise in the following manner: An apical cell of the axis divides into a growing tip cell and a branch cell as before (FIG. 4). This branch apical cell cuts off below disk-shaped segments until a filament of 9–30 cells is formed (FIG. 7). It then divides as did the apical cell into two, from

* Longitudinal will be used throughout as indicating a division parallel to the axis; transverse as across the plant.

which come the long narrow monosiphonous hairs (1–many cells in length) at the apex (FIGS. 6, 7, 8). In the case of the plant having three hairs, the formation of the third hair presents no variation. After the second apical cell has been separated off, the larger lower cell again increases laterally and a third cell is formed by division. After the hairs begin their formation no further transverse split takes place in the branch cells already formed, thus fixing definitely at this point the number of segments in a mature branch. The first divisions of the branch cells are similar to those of the stem. Two longitudinal divisions split the filament into a plate of cells in three rows (FIG. 10). But now a characteristic change takes place in the two outer rows. In these cells an oblique wall, first occurring in the upper half, splits off a triangular cell one third the size of the original, then a second of like shape and size in the lower half, forming three cells: an inner pericentral cell of the same height but one half the width, and two outer marginal cells, one lying above the other, one half as long and one half as wide as the original cell (FIG. 9). Simultaneously with these divisions two longitudinal ones in the central row of cells divide it into a midrib, three cells in thickness. These divisions all begin at the base of the branch and proceed to the apex. A flat-branch segment in distinction from an axis segment now consists of nine cells; three in the midrib, a pericentral cell on each side of the midrib, and beyond each of these two small marginal cells. These segments are of a similar structure throughout the branch with the exception of 2–4 at the base, which do not form the small marginal cells, but have four pericentral siphons like those of the main axis.

Up to the present time, so far as my knowledge goes, the tetraspores have been the only known organs of reproduction of *Taenioma*. These have been mentioned both by Bornet and Thuret, and by Agardh. Bornet and Thuret ('76) merely figure and describe very briefly the gross appearance and position of the stichidia with no account of the tetrasporic formation. Agardh ('63) gives a fuller account, but yet does not satisfactorily present in detail all cell divisions taking place in the stichidia. This account will supplement both the above, as well as the later description and figures given by Falkenberg. In the material examined,

both the Porto Rican plant with the three-haired branches, and the Bahamian one with the two-haired branches produced tetrasporic stichidia. Agardh ('63) speaks of the stichidia as "often excurrent at the top into three minute hairs, of which the middle one continues the middle part of the segment [*i. e.*, the midrib] the marginal ones the marginal cells" [translation]. This corresponds exactly to my Porto Rican material. There the tetrasporangia are formed in stichidia on the flat shoots of the secondary axes in considerable number (FIG. 12). These stichidia are flat branches which remain practically unmodified except that, with the formation of the large tetraspores, they become somewhat broader. The tetrasporangia are formed in two long rows from the two pericentral cells which lie one on each side of the midrib. A transverse division first separates these cells into an upper and a lower half (FIG. 13). The upper half becomes the mother-cell of the tetraspores. The lower half divides by two longitudinal divisions parallel to the flat surface of the branch into a layer of three cells in thickness. These become crowded and elongated in a radial direction by the growth of the tetraspore mother-cells. The upper half of the pericentral cell enlarges greatly to form the tetraspore mother-cell, which still remains in protoplasmic communication with the lower layer of supporting cells. To form the tetraspores, the contents of the mother-cell divide first into two by a longitudinal wall parallel to the flat surface of the stichidium (FIG. 14). A transverse division forms two tetraspores from one half, and another division, at right angles to the planes of the first two divisions, correspondingly forms the two in the second half. These are therefore one form of "cruciate" tetraspores. They are held within the mother-cell wall, which breaks when mature, allowing the tetraspores to escape. These lateral pericentral cells are the only ones to be modified, the midrib and the marginal cells being unchanged. The entire branch or only a portion of it may be transformed into a stichidium.

Little has been known heretofore concerning the antheridia. Falkenberg ('01) figures a shoot bearing two large conical protuberances, seemingly filled with, or composed of, small cells, but he rightly concludes that these are malformations and not antheridia. De-Toni ('00) mentions antheridia as spots between the

middle vein and the margins of the branches, a description which does not wholly correspond to the antheridia as seen in the material at hand. In this, antheridia are formed, as are the tetrasporangia, in ordinary flattened branches, clustered near the growing tips of the secondary axes (FIG. 15). The entire branch (with the exceptions noted below) is usually transformed into antheridial cells, although these may be found only in the middle portion, while the cells at base and apex of the branch remain unchanged. In the formation of the antheridia the first divisions occur in the row of marginal cells. A longitudinal split cuts each into two (FIG. 17). After the first division of the marginal cells into two, the outer row of these never divides again, so that, in the mature antheridium, there is always to be seen a row of marginal cells one half the size of the original ones (FIG. 18). The inner row divides irregularly into many small cells. The lateral pericentral cells now become modified, being cut by both longitudinal and transverse divisions into numerous small cubical cells (FIG. 16). Before these are entirely completed, a longitudinal split parallel to the flat surface of the shoot takes place. This causes the shoot to become a flattened plate of small angular cells, two layers of cells in thickness, with two exceptions: (1) the midrib, which remains entirely unchanged, and (2) the marginal cells. Next, the true antheridial cells are separated from these mother-cells in the two layers on the side toward the surface of the flat shoot (FIG. 19). These very small, ovoid bodies, containing the spermatia, are all in protoplasmic connection and are formed 2–4 to a mother-cell, 4 being probably the normal number. At regular intervals in the antheridial branch there can be noticed a faint line of separation from the midrib to the margin, denoting the original separation of cells into segments (FIG. 15).

Although the tetraspores have been known since the plant was first described, and the presence of antheridia has more recently been alluded to, the cystocarp has been absolutely unknown. De-Toni ('00) says specifically "Cystocarpia ignota" and other literature on the subject does not mention them at all. It has been my good fortune to find in the material collected at Porto Rico a number of cystocarpic specimens. Unfortunately the material has not afforded sufficient stages to trace the growth of the cystocarp from its beginning, nor has there been a sufficient number of

mature cystocarps to make sectioning by microtome possible. The young material was not satisfactory. No procarps were distinguishable as such, although in several instances there appeared to be distortions of normal cells, forming slight protuberances, looking like small malformed branches in some cases. Here indications were found of a row of three small cells which led me to consider the possibility of these being unfertilized and disorganized procarps. In no case was a trichogyne found. The young stages of the cystocarp, when crushed, lost all cell connections, so that no details of their interior structure could be seen. The mature cystocarp from its position is a modified branch, and is situated directly on an axis, not on a flattened branch (FIG. 20). It is a prominent flask-shaped, sessile body, resembling that of *Dasya*, with a large rounded base containing the carpospores, and a long narrow neck which opens at the tip by a distinct carpostome. (The cystocarp pictured is not fully mature, hence the neck is shorter than normal.) The outer covering of cells appears to be continuous with the pericentral cells, and thus probably developed from them. The wall cells are irregularly angular and one layer in thickness. By crushing the material and noting the position of parts, the cystocarp appears to correspond in many details with those of the Rhodomelaceae, especially with those of *Dasya* and *Chondria*, as described by Phillips ('96). The paranematal filaments which he mentions in all these forms are here very apparent; they consist of about 12 chains of cells springing from the base of the cystocarp; but their origin could not be distinguished. These filaments extend to the carpostome. They are narrow and distinct, and do not form in any sense an inner lining to the cystocarp. Also, on crushing, the following structures appeared to constitute the inner apparatus of one cystocarp, which structures were later confirmed by those from a second (FIG. 21). In both cases a comparatively large central cell bore at its apex, by deep pit connections, four large rounded cells. From these proceeded long branching filaments, the sporogenous filaments, on whose tips were borne the large ellipsoidal carpospores. At the base of this central cell was attached a single cell, in the first case examined, and three cells in the second case. Since the central cell was larger in the first, it might be suggested that the cystocarp was older and that a process of absorption of the surrounding cells by the central cell (an auxiliary cell?) was

taking place during the formation of the carpospores. In the second case, not pictured here, one of the lower lateral cells is producing a mass of branching filaments. In two other cystocarps, before crushing, a cluster of filaments was observed at the base of the true spore clusters. This cluster was formed of small elongated cells, densely branching, and apparently without carpospores. Although their connection with the main cells could not be discovered, the question suggested itself: might these not be the two branches of sterile cells found by Phillips ('95, '96) in all the Rhodomelaceae? From this necessarily incomplete account, which merely suggests the identity of the structures observed, it can be seen that much more investigation remains to be done on the cystocarp.

According to the classification of Schmitz & Hauptfleisch ('97), *Taenioma* is placed in the family Delesseriaceae. This position is determined from the similarity of the thallus to those of some members of that family, such as the well-known *Caloglossa*, and also from the formation of the tetraspores in two rows along a midrib. This would seem logical when the tetrasporic reproduction was the only method known. However, with the discovery of the cystocarps, and their strong resemblance to those of *Dasya* and *Chondria*, as described by Phillips ('96), it would seem as if *Taenioma* had been wrongly placed, and that it belongs in the family Rhodomelaceae. The structure of the thallus and the method of branching, resemble that of the simpler members of the Rhodomelaceae and the formation and position of the tetraspores are not such as to exclude it from this latter family. Indeed, from Hauck's ('85) description of the placentation of the cystocarp it must belong here. According to his descriptions the distinguishing mark of the Delesseriaceae is the broad basal placental cell of the cystocarp, from which the sporogenous filaments come in clusters. In distinction to this the placentation in the cystocarps of the Rhodomelaceae is an upright central cell bearing the branching sporogenous filaments at its apex. On comparison with FIG. 21, the latter method of placentation is clearly recognized to obtain in *Taenioma*, which undoubtedly would cause this alga to be placed in the family Rhodomelaceae.

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Explanation of plates 9 and 10

Slides were prepared by staining with eosin and fixing with acetic acid, and by further treatment with potash and lactic acid.

Drawings were made with an Abbé camera lucida, and are reduced one half.

Figures 1–11 were drawn from the Bahamian material; figures 12–21, from the Porto Rican.

1. Portion of the prostrate main axis (× 45).
2. Segment of the axis with rhizoids (× 107).
3. Growing apex, showing alternation of branches (× 107).

4–11. Development of flat shoot (× 278).

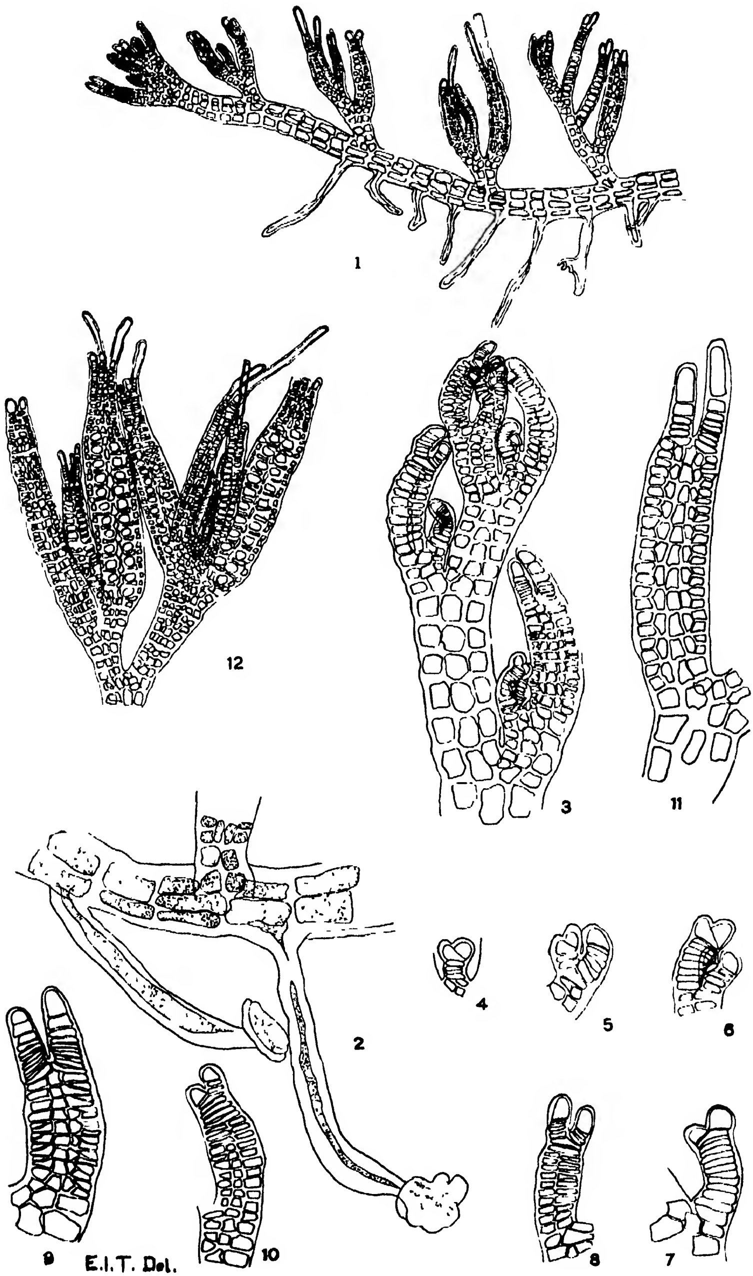
4. Division of apical cell.
5. Main axis with young branch.
6. Division of apical cell to form hairs.
7. Branch showing filament of cells.

8, 10. First longitudinal divisions of shoot.

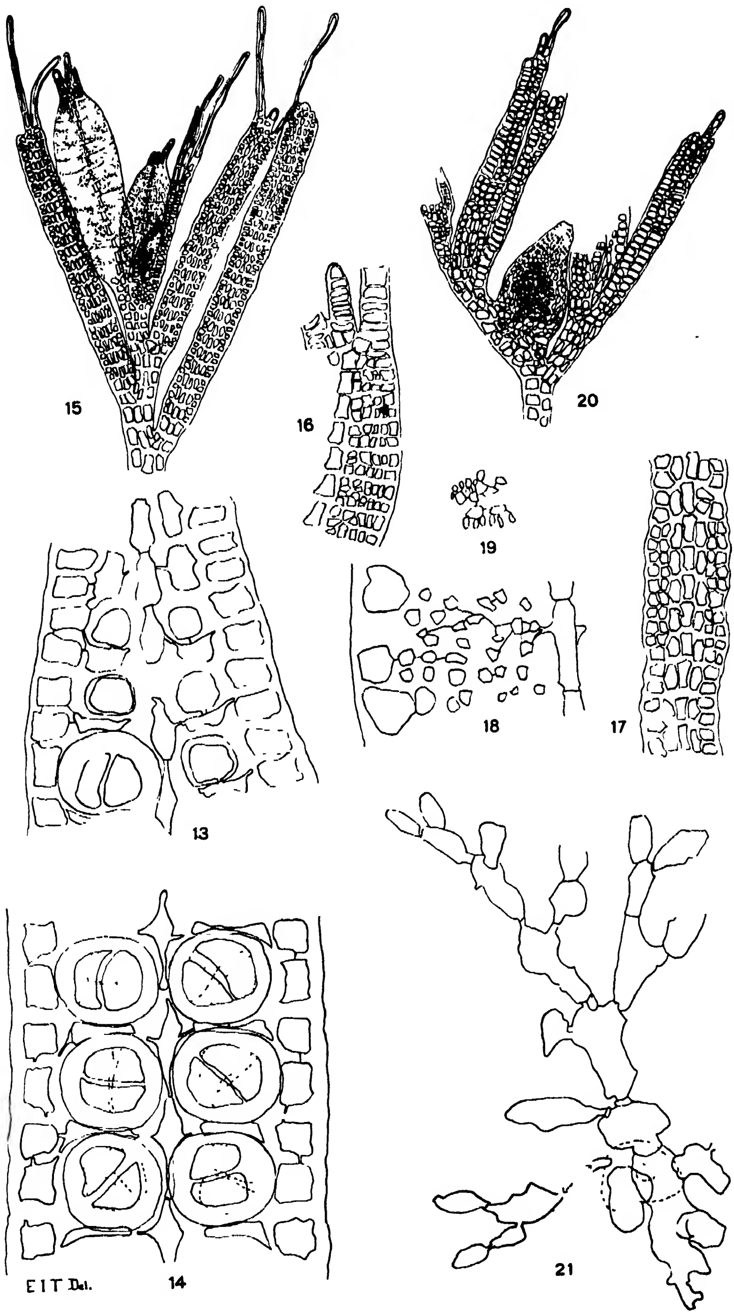
9. Divisions forming marginal cells.
11. Fully formed shoot.
12. Branch bearing stichidia (× 45).
13. Portion of stichidium, showing division of pericentral cells to form tetrasporangium (× 278).
14. Mature stichidium with fully formed tetraspores (× 278).
15. Branch with antheridia (× 45).

16–19. Development of antheridia.

16. Divisions in pericentral cells (× 278).
17. First division of marginal cells (× 107).
18. Portion of discharged antheridium (× 360).
19. Antheridial cells with mother cells (× 360).
20. Branch with cystocarp (× 45).
21. Interior cells of cystocarp (× 278).



THOMPSON: MORPHOLOGY OF TAENIOMA



THOMPSON: MORPHOLOGY OF TAENIOMA

A botanical and geological trip on the Warrior and Tombigbee rivers in the coastal plain of Alabama

ROLAND M. HARPER

Since Nuttall's memorable journey of exploration on the Ohio, Mississippi, and Arkansas Rivers in the years 1818 to 1820,* probably very few botanists have traveled any considerable distance by daylight on any of the navigable rivers of our coastal plain. At the present time passenger traffic has almost ceased on many rivers which were once important arteries of commerce, partly on account of railroad competition and partly on account of great variations in the volume of water, due presumably to deforestation of drainage areas; and even where there are still regular lines of steamboats it is not easy to plan a satisfactory trip on one of them. For the boat schedules are in many cases irregular, infrequent, or not widely advertised, and the connections with railroads too often inconvenient or uncertain; and above all, when a river journey extends over 100 miles or so a part of it is usually made at night and a good deal of scenery thus missed.

On account of these conditions, previous to the fall of 1908 I had traveled on a river boat but once (and that was for a distance of only about twenty miles, on the Tennessee River in the Paleozoic region of Alabama); but in October of the year named a rare opportunity was presented for a much more extensive river trip, all by daylight, and at the same time with ample facilities for botanizing. An expedition was being organized by Dr. Eugene A. Smith, state geologist of Alabama, for the purpose of clearing up a few doubtful points in stratigraphy by examining the exceptionally complete geological sections displayed in the river-bluffs between Tuscaloosa and Mobile; and the writer was invited to participate. The other members of the party were seven well-known geologists besides Dr. Smith (most of them connected with state geological

* See his "Journal of travels into the Arkansa territory," published in 1821, and reprinted in 1905 as vol. 13 of Thwaites's "Early western travels."

surveys in the southeastern states), a young minister (who was also a conchologist), a navigator, and a negro cook.

The trip was made in an old house-boat refitted for the occasion, towed by a 20-horse-power gasolene launch. Our best speed (including the acceleration of the current of something like a mile an hour) was about six miles an hour; and the distance covered between sunrise and nightfall each day averaged about twenty-six miles, but varied greatly with the number of bluffs to be examined and the difficulties encountered, from one to forty-nine miles.

Our voyage began on the morning of October 7, 1908, at the fall-line on the Warrior River, in the city of Tuscaloosa, and ended on the evening of the 16th at Jackson, near the head of tide-water on the Tombigbee, 261 miles from Tuscaloosa and 100 from Mobile, by the river. Although there would doubtless have been much of botanical interest below Jackson,* the geologists did not care to go any farther than that, for there are said to be no important bluffs on the tidal part of this river. The river at this time was almost at its lowest stage, because its headwaters are mostly in regions which have their greatest rainfall in winter and spring and least in summer and fall, as seems to be the case in most of the country between the mountains and the coastal plain in the southeastern states.† This state of affairs greatly facilitated our examination of the banks, but at the same time it caused most vexatious delays at the shallowest places, which were usually just below the mouths of swift creeks, which bring down coarse sand and gravel faster than the slower current of the river can remove it, and thus form shoals.

But on the whole probably no better season of the year could

* A description of some of the swamps between Jackson and Mobile can be found in Bartram's Travels, part 3, chapter 6; and parts of the same have been described in some of Dr. Mohr's writings. For the region now under consideration there is hardly any previous botanical literature to be cited. Excellent geological descriptions, with cuts of some of the bluffs, by Dr. Smith and others, have been published in Bulletin 43 of the U. S. Geological Survey, 1887, and in the "Report on the geology of the coastal plain of Alabama," issued by the state survey in 1894.

† The surface of the Warrior River at Tuscaloosa is about 90 feet above sea-level at low water, usually in October, and 150 feet at high water, usually in March. (Farther down stream the elevations are of course proportionately lower.) The smallest flow ever recorded there was 90 cubic feet a second, on October, 15, 1897, and the largest 136,687 cubic feet, on April 18, 1900; an enormous variation. The average is about 8,000, which is nearly two cubic feet a second for every square mile drained.

have been selected, for we enjoyed ideal weather most of the time, and entire freedom from mosquitoes; and although not many plants along the river were in bloom, there were few if any which were not in the right condition for identification.

One of the indirect effects of civilization in Alabama is that locks and dams now have to be provided in the larger rivers to make navigation possible at all seasons.* There are to be nine locks between Tuscaloosa and Jackson when the contemplated river "improvements" are completed, but at the time of our trip the second and third (counting from tide-water) were unfinished, and all our difficulties were in the part of the Tombigbee to be served by them, a distance of not quite fifty miles. This system of locks, while it seems to be an economic necessity, is a detriment to science in more ways than one. In the first place, it seriously interrupts the normal life-history or physiographic development of the rivers, and, what was of more concern to our party, it has permanently covered the lowest few feet of one of the most important bluffs with an opaque screen of muddy water.†

The Warrior River has its sources among the Carboniferous plateaus of northern Alabama, leaves the highlands at Tuscaloosa, and at Demopolis, 130 miles farther down, joins the Tombigbee, which derives most of its water above that point from the Cretaceous region of western Alabama and northeastern Mississippi. The Warrior between Tuscaloosa and Demopolis probably averages a little less than 100 yards in width, and the Tombigbee between Demopolis and Jackson a little more. In most of what follows the two rivers will be treated as one, the fact that the name of the lower portion continues up the western instead of the eastern branch at Demopolis being more or less arbitrary or accidental. After passing through Tuscaloosa County this river forms a county boundary the rest of the way to the Gulf,‡ passing the

* Locks for navigation are practically unknown in the other southeastern states, probably because those states have much less heavy freight, such as coal and cement, to export than Alabama has, and also partly because most of the navigable rivers in the other states could not be dammed up much without flooding large areas.

† The only known station in Alabama for *Hymenocallis coronaria* (see Mohr, Contr. U. S. Nat. Herb. 6: 447. 1901) has probably been destroyed by this time, by the same process.

‡ It is probably largely for this reason that there are no wagon bridges across it below Tuscaloosa County.

following counties alternately on the right and left: Greene, Hale, Sumter, Marengo, Choctaw, Clarke, and Washington (besides Baldwin and Mobile below the point where our journey ended).

Like most rivers of gentle slope, this one meanders so that distances by water are about twice as great as by air line, and forms bluffs on the convex sides of the bends in the usual manner. The bends are naturally shorter and sharper on the Warrior than on the Tombigbee, on account of the smaller volume of water; and for some reason not altogether obvious, they seem to be most frequent in the region of the Eutaw formation, in the upper parts of Hale and Greene counties.

The banks of the river present a variety of aspects, according to the material of which they are composed, and their position with respect to the meanders and to the sun. Lithologically they are sandstone, limestone, clay, sand, mud, or various intermediate conditions; and there is often considerable variation in a single formation. The oldest material is the stratified Cretaceous and Eocene rocks, which in some places extend as much as 200 feet above the water, in steep bluffs, and elsewhere are entirely under water, or concealed by later formations. Capping the stratified rocks on bluffs which extend above high-water mark can often be seen the stiff reddish loam of the Lafayette formation, which is probably Pliocene. Bluffs not more than 30 feet high are often composed entirely of "second bottom" deposits (Pleistocene), which are usually of loose buff-colored loam, and level on top for considerable distances. Recent alluvium is confined chiefly to low banks subject to frequent inundation. These are of comparatively limited extent, however, and there is very little swamp along any of the rivers in the Cretaceous and Eocene regions of Alabama.

The alluvial banks often slide into the river, carrying down whatever trees grow on them (mostly willows in such places) and drowning them. This phenomenon is especially common in the region of the Tuscaloosa formation (which consists mostly of slippery clay, and lines the river-banks for the first 60 miles below Tuscaloosa), where rows of dead willows are in sight from nearly every point. In this same portion of the river, and apparently nowhere else on our route, are many cut-offs or ox-bow lakes, showing that the channel has been shifting there rather fre-

quently. The bars of sand and gravel which give rise to shoals have been mentioned above.

In Choctaw, Clarke, and Washington counties on the last two days of the trip we got frequent glimpses of the "mountains," which are a characteristic feature of this part of Alabama * and adjacent Mississippi, but are almost unknown to botanists and geographers. These are high rocky ridges, mostly of the buhrstone (Middle Eocene) formation, extending in a general north-

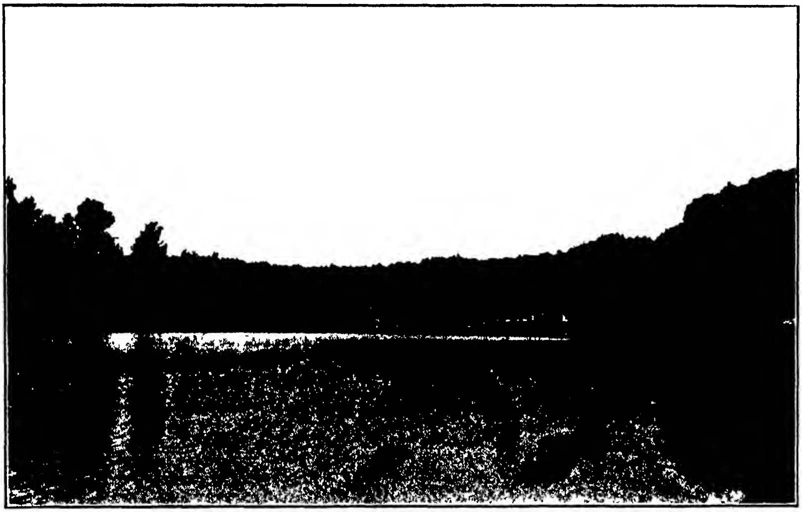


FIGURE 1. Mt. Ararat (near the center) and McCarthy's Bluff, Choctaw County, Alabama, looking downstream from the boat, October 15, 1908.

west-southeast direction. In a few places where the river impinges directly against them they form bluffs over 200 feet high, which is "doing pretty well" for the coastal plain. A distant view of one of them is subjoined. A few plants which grow on them are mentioned in the geological reports cited, and some others will be discussed in the latter part of this paper.

Four divisions of the Cretaceous strata are represented in western Alabama, namely, the Tuscaloosa, Eutaw, Selma Chalk or Rotten Limestone, and Ripley. These are quite easily recognized along the river by their different appearance or lithological

* See Smith, Tenth Census U. S. 6: 55 (line 11), 143–145 [bottom pagination]. 1884; U. S. Geol. Surv. Bull. 43: 35–42. 1887; Geol. of Coastal Plain of Ala. 620–622, 630, 633, 634, 640–641, 645–647. 1894; Mohr, Contr. U. S. Nat. Herb. 6: 107. 1901.

composition, and in the country away from the river by their characteristic topography and vegetation. The Eocene, which begins at Moscow Bluff on the Tombigbee, about 15 miles below Demopolis and just above the upper mouth of Sucarnochee Creek in Sumter County, has numerous subdivisions, which are not so easily recognized by one who is not a paleontologist, and therefore scarcely need to be mentioned here. Details concerning them can be found in the geological reports cited above.

Except for the locks already mentioned, civilization has not done much damage along the banks of these rivers. The highest bluffs are not cultivated because of their difficulty of access, and the lowest banks because of their liability to inundation, so that such places are generally pretty well wooded. The cultivated fields visible from a boat are mostly in the "second bottoms," just above the reach of floods. And such locations are not considered very healthy to live in, consequently not many houses are to be seen. Cotton warehouses, with inclined tracks leading down to the water, are frequent on the bluffs of the lower Tombigbee, but rare or absent on the Warrior, probably largely because there navigation has hitherto been almost impossible in the fall, which is the cotton season. Lumbering has apparently not been carried on much in the region we traversed, probably because the prevailing trees near the river are hardwoods and short-leaf pines, for which there is not much demand. Long-leaf pine, the most important tree in Alabama, seldom grows on river-banks, but after we came within its range (which was not until the second week) we passed several wood landings and even a few logging railroads, by means of which the trunks of this noble tree were being hauled down from the uplands and embarked on their voyage to the seaport sawmills. Cypress, the most important river-bank tree of the coastal plain, probably never was very abundant along our route, for the banks are in most places too steep for it.

Having sketched the main geographical features of the river, we are now ready to consider in some detail the vegetation along its banks. While the boat was moving I wrote down the names of all the species I could identity, starting anew after every recognizable landing, bluff, creek, etc. As we usually kept near the middle of the river, and no one had thought to bring along a field-

glass, my notes made on the boat were chiefly confined to trees, shrubs, and vines. But our frequent stops at the bluffs, lasting from half an hour to several hours or all night, gave me opportunity to note many herbs and check up my identifications of the woody plants, and to do a little collecting. A few short trips away from the river on foot were also made, the longest being from Beckley's Landing in Marengo County via Myrtlewood to Naheola ferry, a walk of eight or ten miles (with one companion), which cut off about fifteen miles of river. The plants noted on such trips are not counted with those on the river-banks, however.

One extreme method of treating the plants observed would be to combine them all in a single list, and the other would be to consider each geological formation separately and classify the plants growing on or near it according to habitat, as far as possible. But the former method would obscure some interesting features of distribution, and my notes are not complete enough to make it worth while to attempt the latter. Another method would be to consider the Warrior and Tombigbee Rivers separately, thus dividing the journey into two equal parts. But this would be rather arbitrary, for the upper Tombigbee does not flow through any kind of country that the Warrior does not, so that there was no perceptible change of natural conditions as we passed Demopolis except an increased flow of water. (If we had started at the head of navigation on the Tombigbee instead of on the Warrior, then Demopolis might have been a logical dividing point, for the Warrior doubtless brings down from the mountains seeds of quite a number of plants which do not grow along the upper Tombigbee at all.)

The dividing line between the Cretaceous and Eocene formations is a line which several species growing along the river do not seem to cross, and by dividing the notes there some interesting features of distribution can be brought out. That method is here adopted.

In the following table the plants of the Cretaceous and Eocene portions of the river banks are listed in parallel columns. They are divided first into trees, shrubs, and herbs, then arranged in order of apparent frequency, the number prefixed to each being the number of times it was noted in the region under which it is

listed. Those seen only once or twice are omitted from this table. The names of vines are italicized, evergreens are in small capitals,* parasites in parentheses, and epiphytes in brackets.† Author-citations are not considered necessary here, and times of flowering, modes of dissemination, etc., are not accurately known in most cases, and are therefore omitted. All the plants visible from the river naturally do not have the same habitat, but it is hardly worth while at this time to go into details of zonation, etc. I have however added the symbol (H) to the names of those species which were seen only on high bluffs or in hammocks or second bottoms, above ordinary high water. Species which grow sometimes above and sometimes below this level are indicated by (h).

CRETACEOUS

TREES

99 Salix nigra
91 Platanus occidentalis
78 Betula nigra
75 Acer saccharinum
68 Planera aquatica
65 Populus deltoides
61 Taxodium distichum
50 PINUS TAEDA (H)
30 Hicoria aquatica
30 Liquidambar Styraciflua (h)
19 Quercus lyrata
9 Fagus grandifolia (H)
8 QUERCUS LAURIFOLIA (H)
6 Morus rubra
5 JUNIPERUS VIRGINIANA (H)
5 PINUS ECHINATA (H)
4 QUERCUS NIGRA (h)
3 Carpinus caroliniana (h)

EOCENE

TREES

82 Salix nigra
77 Populus deltoides
47 Platanus occidentalis
38 Acer saccharinum
24 Planera aquatica
23 Taxodium distichum
22 Betula nigra
14 PINUS TAEDA (H)
11 PINUS GLABRA (H)
9 Liquidambar Styraciflua (h)
7 MAGNOLIA GRANDIFLORA
7 Fraxinus americana ?
5 Fagus grandifolia (H)
3 Morus rubra (h)
3 Hicoria aquatica
3 Cercis canadensis (H)
3 ILEX OPACA (H)

* [The author preferred to use bold-face type for the evergreens, but for the past eleven years the BULLETIN has reserved that style of type for new names and new combinations of names. — ED.]

† For a more detailed explanation of this method of treating plant lists, see Ann. N. Y. Acad. Sci. 17: 36–39. 1906.

CRETACEOUS

SHRUBS

73 *Brunnichia cirrhosa*
50 (PHORADENDRON FLAVESCENS)
45 ARUNDINARIA MACROSPERMA
16 Alnus rugosa (h)
15 *Tecoma radicans*
7 *Rhus radicans*
5 *Vitis vulpina*
4 Amorpha fruticosa
4 *Ampelopsis arborea*
3 *Bignonia* CRUCIGERA (h)
3 *Ampelopsis cordata*
3 Adelia acuminata

HERBS

36 Onoclea sensibilis
36 *Sicyos angulatus*
20 Aster lateriflorus
18 [TILLANDSIA USNEOIDES]
12 Conoclinium coelestinum
11 Fimbristylis Vahlii
9 Uniola latifolia
7 Osmunda regalis
4 Dianthera americana
4 Panicum virgatum (h)
3 Xanthium sp.
3 [POLYPODIUM POLYPODIOIDES]
3 ADIANTUM CAPILLUS-VENERIS

EOCENE

SHRUBS

44 (PHORADENDRON FLAVESCENS)
25 *Brunnichia cirrhosa*
15 ARUNDINARIA MACROSPERMA
12 Adelia acuminata
12 *Tecoma radicans*
9 *Vitis vulpina*
5 *Ampelopsis arborea*
4 Amorpha fruticosa
4 *Rhus radicans*
3 Cephalanthus occidentalis

HERBS

48 [TILLANDSIA USNEOIDES]
42 *Sicyos angulatus*
14 Dianthera americana
14 Xanthium sp.
9 Onoclea sensibilis
7 *Ipomoea lacunosa*
6 Spermacoce glabra
6 Acuan illinoense
5 Amaranthus sp.
5 Paspalum mucronatum
5 Sesbania macrocarpa
5 Ammannia coccinea
4 Fimbristylis Vahlii
4 Eclipta alba
4 Panicum virgatum (h)
4 Andropogon furcatus (H)
4 Cardiospermum Halicacabum
3 Commelina hirtella
3 Acalypha virginica
3 Euphorbia nutans
3 Echinochloa Crus-galli
3 Leptochloa mucronata
3 Euphorbia humistrata?
3 *Gonolobus laevis?* *
3 Sida spinosa

* *Gonolobus laevis* Michx. (*Enslenia albida* Nutt. See Vail, Bull. Torrey Club **26**: 427, 428. 1899.) The plants I examined differ from current descriptions in having no milky juice, and follicles neither angled nor erect; but most descriptions seem to be silent on these points, perhaps not without reason. I preserved no specimens.

The higher numbers for the shrubs and trees in the first column are of course due principally to the fact that we traveled 145 miles through the Cretaceous and only 116 through the Eocene. The slightly greater number of woody plants in the Cretaceous list may be due to the same cause, and the excess of herbs in the second column to the fact that we landed oftener in the Eocene region; but there is also a possibility that this may be a part of the general tendency for woody plants to be most numerous in climax forests and herbs in pioneer forests—the Cretaceous region having of course been above the sea longer than the Eocene.

A few words on habitats should be inserted here. The favorite habitat of the *Alnus*, *Aster*, *Onoclea*, *Osmunda*, and *Adiantum* was at the line of contact between the Cretaceous and second-bottom deposits, where water is perpetually seeping out, on shaded bluffs of moderate height. In such places the four herbs just mentioned usually hang down against vertical cliffs, which in the case of the *Onoclea* and *Osmunda* at least is somewhat of a departure from their habit elsewhere. The *Dianthera*, *Ammannia* and several Cyperaceae not seen often enough to be mentioned in the above table commonly grow on gently sloping clayey Eocene strata near the bases of bluffs, where they are usually moistened by trickling water from above when the river is low and completely submerged when it is high. The *Phoradendron* seemed to grow oftener on *Populus* than on any other tree. It was also frequent on *Acer*, less so on *Betula*, occasional on *Platanus*, but apparently never on *Salix*, *Planera*, or any of the conifers.

If the hammock and high bluff plants, which happen to be mostly trees, be disregarded, the most striking features of both lists are the scarcity of evergreens and the large proportion of vines. This seems to be characteristic of most alluvial forests in temperate eastern North America, especially those of the Mississippi Valley type.* A dense tangle of at least half a dozen species of vines was nearly always in sight, giving the banks in some places, especially where low and swampy, somewhat the appearance of the proverbial tropical jungle. (Many of the species, curiously enough, have near relatives in tropical America.)

The parallel column arrangement brings out the relatively

*See Ann. N. Y. Acad. Sci. 17: 69–73. 1906; Torreya 10: 62. Mr 1910.

greater prevalence of *Platanus*, *Betula*, *Hicoria aquatica*, *Quercus lyrata*, *Juniperus*, *Alnus*, *Onoclea*, *Aster lateriflorus*, *Conoclinium*, *Uniola*, and *Osmunda* in the Cretaceous region, and of *Populus*, *Pinus glabra*, *Magnolia grandiflora*, *Adelia acuminata*, *Vitis vulpina*, *Tillandsia*, *Dianthera*, *Acuan*, *Spermacoce*, *Paspalum mucronatum*, *Ammannia*, and a few others in the Eocene. All of the former are species of more or less climax tendencies, and all but one or two of them are common above the fall-line, so it is not surprising that they are less frequent coastward. Most of the latter, on the other hand, are confined to the coastal plain, or nearly so. *Alnus rugosa*, common in the Cretaceous, was not noticed in the Eocene region at all, while the reverse is true of *Pinus glabra*, *Magnolia grandiflora*, and *Acuan illinoense*.

Considering the table as a whole again, it is noteworthy that most of the species seem to have their greatest development (or centers of distribution) in the Mississippi Valley,* and that most of the monocotyledonous and many of the dicotyledonous genera have tropical representatives. The families most largely represented in the table are Compositae, Euphorbiaceae, Leguminosae, Cupuliferae, Cyperaceae, and Gramineae. Such large families as Solanaceae, Labiatae, Gentianaceae, Ericaceae, Umbelliferae, Hypericaceae, Rosaceae, Cruciferae, Caryophyllaceae, Ranunculaceae, Orchidaceae, Liliaceae, and Juncaceae, and such genera as *Viola*, *Carex*, *Rynchospora*, *Scirpus*, and *Panicum*, which are well represented in other parts of Alabama, are scarce or absent on the river banks. About 20 per cent. of the angiosperms are monocotyledons, but perhaps the number of species involved is too small for this fact to be of much significance.

The weeds † along the river furnish an interesting problem. I was surprised to find them so numerous in spots so remote from human habitations and so rarely trod by the foot of man. They are common on all the bluffs, and as many of them are known to have been introduced from foreign countries in comparatively recent times, the vegetation of some parts of the river-banks must present quite a different appearance now from what it did a cen-

* See Ann. N. Y. Acad. Sci. 17: 74. 1906; Torreya 7: 44. 1907.

† By "weed" is here meant a species which grows chiefly in unnatural habitats created by civilization. See Bull. Torrey Club 35: 347. 1908.

tury or two ago. Those which were seen more than twice have already been listed above with the native species, without any attempt to separate them. These will be mentioned again below, together with the less frequent weeds.

For the occurrence of so many weeds (about 40 species were noted on the trip) in such out-of-the-way places the following explanation is suggested: The edaphic conditions on the banks are very diverse, each subdivision of the Cretaceous and Tertiary, as well as the Quaternary second bottoms, furnishing one or more different types of rock or soil, some of which extend only a few feet vertically and a few hundred yards horizontally. In addition to this, the different bluffs face all points of the compass, so that there is a change of environment with every bend in the river. Now if every different formation (and some of them are very different from anything exposed on level ground away from the rivers) had one or more peculiar species adapted to it by processes of evolution, every such river would be bordered by many endemic and very local species. But species (fortunately, one might say) do not seem to be produced quite so freely, and few native plants have been able to grow on the faces of the bluffs at all. The existence of a species confined to a particular kind of river-bluff would be rather precarious, anyway, for the faces of bluffs frequently slough off into the river, destroying all the vegetation on the area affected.

But most weeds are already adapted to diverse soil conditions, and a river is an excellent highway for plants to travel, so that those species which gain access to the river from the fields and settlements along it quickly take possession of the unoccupied bluffs where native plants have been unable to establish themselves. It should not be inferred from this statement however that the bluffs are now completely covered with weeds. A large part of their area is usually too hard or too steep, or crumbling away too rapidly, to afford a foothold for any kind of vegetation, and consequently the bluff weeds are confined chiefly to crevices or to gentle slopes near the base.

Not all of the river-bank weeds are exotics. There seem to be all gradations (if such a thing were possible) between species known to have been introduced from distant parts of the earth and

species which are unquestionably native in the vicinity, as proved by the manner of their occurrence in other habitats. There is no known way of distinguishing which are native and which are introduced species by local observation alone, so recourse must be had to the statements in botanical literature, and those unfortunately are sometimes conflicting. According to the latest and best information obtainable, however, the weeds observed on this trip might be classified roughly according to the origin as follows: (There will of course be room for some difference of opinion here, and further study of the behavior of these plants in other parts of this country and in the tropics is needed.)

1. Species endemic to the Eastern United States, and occurring often in perfectly natural habitats, but also capable of flourishing in weedy places.

Spermacoce glabra, *Diodia virginiana*, *Conobea multifida*, *Ipomoea lacunosa*, *Acuan illinoense*, *Fimbristylis Vahlii*, *Panicum virgatum*, *Paspalum mucronatum*, *Andropogon furcatus*.

2. Species supposed to be confined to the Eastern United States, but occurring almost solely in unnatural habitats. Some of these have perhaps never had suspicion cast upon them before, but they will bear watching.*

Spilanthes repens, *Xanthium* sp., *Diospyros virginiana*, *Euphorbia humistrata* (and perhaps one or two of its congeners which I could not identify with certainty), *Acalypha virginica*, *Meibomia* sp. (perhaps more than one), *Glottidium vesicarium*, *Panicum proliferum*.

3. Species apparently native in the Eastern United States, like those in the first group, but occurring also in tropical America.

Conoclinium coelestinum, *Eupatorium serotinum*, *Tecoma radicans*, *Ammannia coccinea*, *Ampelopsis arborea*, *Commelina hirtella*, *Fimbristylis autumnalis*, *Eragrostis hypnoides*.

4. Species common to the Eastern United States and the tropics, supposed by most writers to be native here, but chiefly confined to unnatural habitats, like those in the second group.

Eclipta alba, *Ambrosia trifida*, *Physalis angulata*, *Jussiaea decurrens*, *Euphorbia nutans*, *Sesbania macrocarpa*, *Cebatha Caro-*

*Bartram's *Oenothera grandiflora*, whose rediscovery farther down this same river in 1904 created a mild sensation among botanists (see Vail, Torreya 5: 9, 10. 1905), probably belongs to the same class.

lina, Mollugo verticillata, Echinochloa Crus-galli, Tripsacum dactyloides.

5. Species believed to have been introduced from the tropics in modern times. (There seem to be no European weeds along these rivers.)

Cardiospermum Halicacabum, Boerhaavia erecta, Leptochloa mucronata, Eleusine indica, Capriola Dactylon, Sorghum halepense.

No information as to relative frequency or local distribution is given in these five lists, but some of the most abundant weeds are mentioned in the first table. Perennials seem to predominate in the first and third classes and annuals in the fourth, but in the whole list of 40 weeds they are about equal in number.

The following notes on particular species are believed to add something worth knowing to our present stock of information about the distribution of each. Specimens of some of them have already been distributed, and such are indicated by numbers.

CAMPANULA AMERICANA L.

Still in bloom on Oct. 16 near the base of St. Stephens Bluff, Washington County, a perpendicular cliff of "White Limestone" about 75 feet high, which faces nearly north. This species is confined chiefly to the Alleghanies and northward, and had never before been reported so far south.

SICYOS ANGULATUS L.

A common vine on densely wooded alluvial banks; seen on every day of the trip, in every county passed, and perhaps over every formation. Still in bloom. Dr. Mohr does not seem to have seen this in Alabama himself, but he reported it from a single locality in Autauga County, where it was collected by Dr. Smith. I have never met with it in any other southern state.

HOUSTONIA ANGUSTIFOLIA Michx.

This is a comparatively rare species, but pretty widely distributed, with a remarkable range of habitat, from limestone rocks to dry sand, both in Georgia and Alabama. On this trip I found it on St. Stephens Bluff, with *Campanula americana.* Dr. Mohr knew it only from dry ridges.

DIAPEDIUM BRACHIATUM (Pursh) Kuntze.

On shaded alluvial banks, Tuscaloosa, Marengo, and Washington counties, nearly past flowering. This genus is an addition to the known flora of the state.

CONOBEA MULTIFIDA (Michx.) Benth.

On exposed loamy banks of the Tombigbee in Sumter County, near Demopolis (*no. 120*) and Moscow. Nearly past flowering. Dr. Mohr knew this only as a ballast plant in Mobile County, but, where I saw it, it seemed as much at home as any of the other river-bank annuals. However, as stated above, there seems to be no criterion for distinguishing native from introduced species in such places.

NYSSA UNIFLORA Wang.

It is perhaps worth recording that this was not seen on the banks of the river at all, but only in a slough on top of a second-bottom bluff in Marengo County nearly opposite the boundary between Sumter and Choctaw. There it was accompanied by *Taxodium distichum*, as is often the case throughout its range.

THASPIUM BARBINODE CHAPMANI C. & R.

On the limestone on the shaded north side of St. Stephens Bluff. Previously known only from Randolph County, Georgia, and Jackson County, Florida, likewise on Eocene limestone.*

AMMANNIA COCCINEA Rottb.

On wet banks, nearer horizontal than vertical, of soft Eocene rock along the Tombigbee in Sumter, Marengo, Choctaw, Clarke, and Washington counties. Known to Dr. Mohr only from Mobile County.

Acer rubrum L. and *Magnolia glauca* L. were not seen at all, probably because they are chiefly confined to areas much farther from base-level (as a physiographer would term it) than the banks of a large sluggish river.

MENISPERMUM CANADENSE L.

On shaded alluvial banks on both sides of the Tombigbee near the northeastern corner of Choctaw County. This is not men-

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*See Bull. Torrey Club 33: 240. 1906; Coulter & Rose, Contr. U. S. Nat. Herb. 7: 148. 1900.

tioned in Mohr's Plant Life of Alabama, but it was later reported from the base of Sand Mountain in Jackson County by T. G. Harbison.* It probably does not extend much farther south than where I saw it.

ADICEA PUMILA (L.) Raf.

On shaded alluvial bank near Beckley's Landing, Marengo County, and in rich shady woods near Hatchetigbee Bluff, Washington County; accompanied by the somewhat similar *Urticastrum divaricatum* at both places. Apparently not reported from the coastal plain of Alabama before.

FIMBRISTYLIS VAHLII (Lam.) Link.

Rather common on exposed loamy banks, considerably below high-water mark, in Greene, Hale, Sumter, Marengo, and Clarke counties. (*Nos. 117, 118.*) This neat little plant evidently cannot stand, or does not have, much competition, for it grows in scattered tufts, unobstructed by other vegetation. A study of its life-history would doubtless bring out some interesting things. As the places where it grows are often under water, its periods of vegetative activity must be subject to considerable interruption.† To offset this, it seems to have a habit of sending up several successive crops of culms during the season, and of course if any one crop succeeds in maturing seed its purpose is accomplished. Some of the specimens collected show two sets of culms of different ages, perhaps a month or two apart.

Not very much is known about the range and habitat of this species. It is rarely mentioned outside of manuals and monographs, and I had never seen it growing before this time and have not seen it since. Its name does not appear in Mohr's Plant Life of Alabama, but singularly enough there is a specimen of it in the Mohr Herbarium at the University of Alabama, from "Damp allu-

* Biltmore Bot. Stud. 1: 155. 1902.

† See notes on one of its near relatives, *F. perpusilla*, in Bull. Torrey Club 31: 17–19. 1904. *F. autumnalis* seems to have similar struggles for existence in some places. Very minute specimens of the latter, some not more than an inch tall, but fruiting, were collected on the muddy bottom of a shallow dried-up pond about a mile west of Black Buff, Sumter County, on October 12 (*no. 122*). See also in this connection Fernald in Rhodora 11: 180. S 1909.

uvial banks, Chastang's Bluff, Sept. 1, 1879," labeled "*Stenophyllus Stenophyllus*"!

HEMICARPHA MICRANTHA (Vahl) Pax.

Seen only on a gentle slope of soft shale (Black Bluff formation), perpetually moistened by water trickling down from the second-bottom deposits a few feet higher up, just below Beckley's Landing, a mile or two north of Myrtlewood, Marengo County, Oct. 13 (*no. 123*). The bulk of the vegetation in this habitat consisted of *Dianthera americana* and various Cyperaceae, one more of which is mentioned below.

This is another species which I have never seen elsewhere in the South. Dr. Mohr reported it from "Low, damp sandy ground, most frequent in flat open grassy pine barrens" (which by the way would be a very unusual habitat for *Hemicarpha*), in Washington, Clarke, and Mobile counties; but the only specimen so labeled in his herbarium at the University (and I am informed that a similar state of affairs exists in his other collection, now deposited in the U. S. National Herbarium), from "Close damp soil, pastures, etc. Mobile. April, May," is *Scirpus carinatus!* *

CYPERUS INFLEXUS Muhl.

Collected at the same time and place as the preceding (*no. 124*), and seen also at Jackson landing, where our river trip terminated. The occurrence of this species in Alabama was not known until I found it on Lookout Mountain in the fall of 1905,† (or in Georgia until I found it on flat granite rocks in Clarke and Clayton counties in the summer of 1900).

HOMALOCENCHRUS LENTICULARIS (Michx.) Scribn.

In wide densely wooded alluvial bottoms, about two miles west of Myrtlewood and the same distance from the Tombigbee River,

* For notes on the occurrence of this species in Alabama, see Bull Torrey Club 33: 525. 1906.

† See Torreya 6: 115. 1906. It is rather a curious coincidence that I should have been the first to find this species and the preceding in Worcester County, Massachusetts, after two or three floras of the county had been published. (See Rhodora 1: 201, 202. 1899.) There they both grow on the sandy shores of two lakes in Brookfield. For other interesting notes on their occurrence together see Haberer, Rhodora 2: 61. 1900; Blankinship, Rhodora 5: 130. 1903; Fernald, Rhodora 11. 220. 1909; Wiegand, Rhodora 12: 39. 1910.

in Marengo County, Oct. 14. Not previously reported from Alabama.

PASPALUM MUCRONATUM Muhl. (*P. fluitans* Kunth).

Not rare, on shaded alluvial banks, Tuscaloosa (*no. 116*), Sumter, Marengo, Choctaw, and Washington counties. This, too, was new to the known flora of the state.

PINUS PALUSTRIS Mill.

The only places between Tuscaloosa and Jackson where this is visible from the river seem to be the crests of the high Buhr-stone ridges or "mountains" above mentioned, in Choctaw and Clarke counties. There a few specimens of this unmistakable pine could barely be distinguished with the naked eye as we floated along. It also grows to some extent on the hills capped with Lafayette red loam around Jackson.

? EQUISETUM ARVENSE L.

Sterile specimens which cannot be distinguished from this species were collected in damp crevices of Ripley (Cretaceous) limestone at Barton's Bluff in Marengo County, about ten miles below Demopolis (*no. 121*). This is just the kind of a place in which one usually finds Equisetums (mostly of the *hyemale* group) in the South, but the finding of *E. arvense* in Alabama was decidedly unexpected. Dr. Gattinger reported it from "moist fields, Cave Spring, E. Tenn.," and Dr. Small in his Flora of the Southeastern U. S. credited it to North Carolina, without definite locality, but these are the only records of its occurrence in the southeastern states that I have found. *E. arvense* in the North is often if not usually a weed, but these specimens appeared decidedly native.

Perhaps if my locality could be visited in spring when the fertile stems are visible this plant would turn out to be something else than *E. arvense*; but it is certainly not one of the three species credited to Alabama by Dr. Mohr, for those are all of the *hyemale* group.

ASPLENIUM ANGUSTIFOLIUM Michx.

Many fine specimens of this, some fruiting (*no. 129*), were found in rich shady woods on the north side of a steep Buhrstone

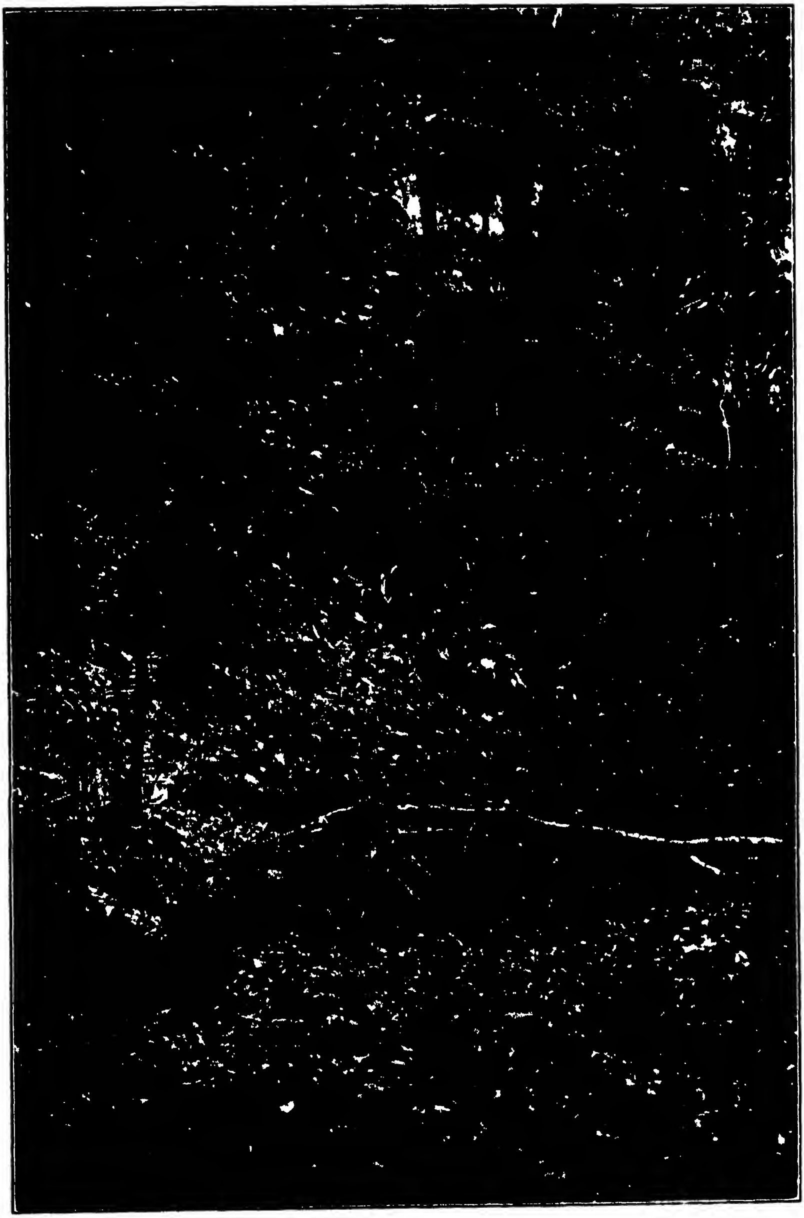

FIGURE 2. Rich shady woods, with *Asplenium angustifolium*, etc., on north side of Hatchetigbee Bluff, Washington County, Alabama, October 16, 1908.

hill rising over 100 feet above the river at Hatchetigbee Landing, Washington County, on the last day of the trip. (See illustration — FIGURE 2.) This was quite a surprise, as the southern limit of this species was previously supposed to be in the mountains of Winston County, about 160 miles farther north and 1,500 feet higher. (The fact that several of the smaller tributaries of the Warrior River flow through Winston County may have something to do with the occurrence of this fern on the Tombigbee.)

At the same time and place I noticed *Scrophularia marilandica*, *Phryma Leptostachya*, *Adicea pumila*, and *Phegopteris hexagonoptera*, which were not known from the coastal plain of Alabama before, and *Panax quinquefolium*, which here reaches just about its southern limit.

TALLAHASSEE, FLORIDA.

Studies on the Rocky Mountain flora—XXI

PER AXEL RYDBERG

Ambrosia media sp. nov.

Annual; stem 4–6 dm. high, hispid with ascending or appressed short hairs, more or less strigose, branched; leaves pinnately divided, thick, 5–10 cm. long, scabrous and glandular-granuliferous above, hispid-strigulose beneath, all except the uppermost with shorter or longer, hirsute-ciliate, narrowly winged petioles; divisions oblong or lanceolate, usually more or less cleft or toothed, the lobes or teeth lanceolate, acute; staminate racemes rather dense; involucre nodding, slightly lobed with 5 rounded lobes and crenulate, 4–5 mm. in diameter, hispid-strigose; hairs about 0.5 mm. long, with more or less pustulate bases; receptacle with few narrow lance-subulate scales; fruit obovoid; body about 3 mm. long, puberulent or in age glabrate, with 5–7 sharp spines 0.5 mm. long and strongly directed forward; beak about 1 mm. long, pubescent.

In the form and texture of the foliage, this species resembles *A. coronopifolia* T. & G. (*A. psilostachya* of most authors) as closely as to make it almost impossible to distinguish the two by the leaves alone, the only difference being that the leaves of *A. media* are more inclined to be petioled and the petioles distinctly hispid-ciliate. Otherwise, the plant is more closely related to *A. elatior* and *A. artemisiifolia,* the root being annual and the fruit spiny. *A. coronopifolia* has a larger fruit, which is inclined to be round-elliptic instead of obovoid, is more pubescent, without spines, either perfectly smooth or rarely with small rounded tubercles.

COLORADO: Fort Collins, Aug. 27, 1885, *C. S. Crandall* (type, in herb. N. Y. Bot. Gard.).

NEW MEXICO: Pecos, San Miguel County, Aug. 20, 1898, *Standley 5138*; Kingston, 1904, *Metcalfe 1337* (?).

COAHUILA: Saltillo 1898, *Palmer 293*.

MONTANA: Sand Coulee, Sept. 7, 1885, *R. S. Williams.*

NEBRASKA: Chadron, Oct. 9, 1897, *J. M. Bates 706* (plants predominantly pistillate).

Grindelia integerrima sp. nov.

Perennial, with a cespitose base; stems about 3 dm. high, glabrous, somewhat angled by the decurrent lines; leaves narrowly oblanceolate, 2–4 cm. long, acute, strongly resinous-dotted, entire; heads numerous, corymbose; involucre about 7 mm. high and 1 cm. wide; bracts lanceolate, with very short, terete, squarrose tips; ligules 6–7 mm. long; pappus-bristles slightly flattened, curved and twisted, 3 mm. long, about the length of the achenes.

This somewhat resembles *Grindelia nana* in general habit but differs in the broader bracts with much shorter tips and the strongly curved and twisted pappus-bristles.

IDAHO: Sandy soil near Granite Station, Kootenai County, July 29, 1892, *Sandberg, MacDougal, & Heller 784* (type, in herb. N. Y. Bot. Gard.).

Grindelia columbiana (Piper) Rydb. comb. nov.

Grindelia discoidea Nutt. Trans. Am. Phil. Soc. **7**: 315. 1840. Not *G. discoidea* H. & A. 1836.

Grindelia nana discoidea A. Gray, Syn. Fl. **1**^{2}: 119. 1884.

Grindelia nana columbiana Piper, Contr. U. S. Nat. Herb. **11**: 556. 1906.

Chrysopsis angustifolia sp. nov.

Chrysopsis stenophylla Britt. & Brown, Ill. Fl. **3**: 327. 1898. Not *C. stenophylla* (A. Gray) Greene. 1884.

Perennial, with a cespitose caudex; stems erect, 2–4 dm. high, canescent and more or less hirsute; leaves narrowly linear-oblanceolate, the lower short-petioled, the upper sessile, 2–5 cm. long, 2–5 mm. wide, acute, grayish-strigose on both sides, somewhat hispid-ciliate on the lower portion; involucres turbinate-campanulate, 8–10 mm. high and about as broad; bracts narrow and linear, acute, grayish-strigose; rays about 1 cm. long; achenes canescent; outer pappus of short bristles; inner pappus-bristles tawny.

This is intermediate between *Chrysopsis foliosa* and *C. stenophylla.* It resembles the latter in leaf-form but differs in being more canescent, less hispid, not at all viscid, and in the bracts, which are narrower, and strigose-canescent instead of hispid and viscid-puberulent. From *C. foliosa* it differs in the narrower, spreading leaves, the more distinctly peduncled heads, and less white pubescence.

NEBRASKA: Middle Loup River, near Mullen, Hooker County, Sept. 14, 1893, *P. A. Rydberg 1766* (type, in herb. N. Y. Bot. Gard. and Columbia Univ.); Long Pine, Sept. 14, 1890, *J. M. Bates;* Deuel County, Aug. 24, 1891, *Rydberg 149*.

KANSAS: Kiowa County, Sept. 4, 1898, *L. F. Ward.*

ALBERTA: Vicinity of Banff, Aug. 14, 1899, *McCalla 2032*, in part.

Chrysopsis Butleri sp. nov.

Perennial; stem decumbent at the base or erect, grayish-hispidulous and slightly hirsute; leaves 1–3 cm. long, the lower obovate, the upper oblong or elliptic, obtuse or apiculate, often spreading, sessile, grayish-hirsute with short hairs; heads peduncled but usually subtended by an oblong small leaf; involucres 8 mm. high, 10–15 mm. broad; bracts linear, acute, hirsutulous, but not at all glandular or viscid; ligules about 8 mm. long; achenes silky-strigose; pappus tawny, the outer of minute bristles.

This species is characterized by the small, obovate or elliptic, subsessile leaves, which are often spreading and with short spreading pubescence. Nearly all the species of the *Chrysopsis villosa* group, with spreading pubescence, are more or less viscid or glandular, but this is not at all the case with *C. Butleri.* In leaf-form it resembles *C. villosa*, but both leaves and heads are smaller and the pubescence is different. In *C. villosa* the hairs are at least in the young state appressed.

MONTANA: Gateway, Aug. 17, 1908, *B. T. Butler 620* (type, in herb. N. Y. Bot. Gard.); Midvale, Sept. 3, 1901, *Umbach 564;* Wild Horse Island, Aug. 13, 1908, *Butler 480, 481, 485, 491.*

WYOMING: Near Fort Laramie, 1842, *Fremont 482.*

UTAH: City Creek Cañon, 1875, *M. E. Jones;* same locality, Oct. 7, 1905, *Garrett 1703.*

Chrysopsis grandis sp. nov.

Perennial, with a cespitose caudex; stems about 3 dm. high, leafy, long-hirsute, hispidulous and resinous-granuliferous; leaves spatulate or oblanceolate, 3–5 cm. long, the lower petioled, the upper sessile, hirsute or hispid and conspicuously resinous-granuliferous, apiculate; heads corymbose, short-peduncled, rarely subtended by a small leaf; involucres 8 mm. high, 12–18 mm. broad; bracts densely hirsute, only slightly granuliferous; rays golden yellow, about 1 cm. long; achenes strigose; pappus yellowish tawny, the outer of short bristles.

This species is related to *Chrysopsis hispida* and *C. columbiana*, but differs from both in the larger heads; it differs also from the former in the more copious pubescence and the more decidedly oblanceolate and petioled leaves; from the latter in the longer pubescence, the more copious resinous granules and the more decidedly petioled leaves.

MONTANA: Jocko Creek, June 16, 1901, *MacDougal 275* (type, in herb. N. Y. Bot. Gard.); also *265*.

Chrysopsis barbata sp. nov.

Perennial; stems about 3 dm. high, more or less tinged with purplish or red, hirsute with long white hairs and somewhat puberulent; leaves sessile, lanceolate, 3–5 cm. long, the upper acuminate, long-hirsute and somewhat resinous-granuliferous; heads subsessile; involucres 1 cm. high and 12–15 mm. broad; bracts linear, acute, sparingly long-hirsute and resinous-granuliferous; ligules about 7 mm. long, golden yellow; achenes strigose; pappus brownish tawny, the outer squamulate, 1–1.5 mm. long.

This species is related to *Chrysopsis hispida* but differs in the long, dense pubescence, a much less abundance of resinous granules, larger leaves and heads, and more conspicuous outer pappus. It grows on sandy plains.

IDAHO: Valley of Spokane River, Kootenai County, July 17, 1893, *Sandberg, MacDougal, & Heller 664* (type, in herb. N. Y. Bot. Gard.).

Chrysothamnus attenuatus (Jones) Rydb. sp. nov.

Bigelovia Howardi attenuata Jones, Bull. Calif. Acad. Sci. II. **5**: 691. 1895.

Chrysothamnus affinis attenuatus A. Nels. Bot. Gaz. **28**: 374. 1899.

Chrysothamnus salicifolius sp. nov.

A shrub 3–10 dm. high; branches erect, white or gray, finely pannose-tomentulose; leaves linear, 3-nerved, 4–6 cm. long, 3–6 mm. wide, minutely tomentulose; heads in a dense corymbiform cyme; involucres 7–8 mm. long; bracts elliptic, oval or ovate, the outer acutish, the inner obtuse or rounded at the apex, erose-ciliate, the outer slightly tomentose, the inner glabrous; corollas about 1 cm. long; teeth 1.5–2 mm. long, lanceolate, obtusish; achenes coarsely strigose, angled.

This species resembles *Chrysothamnus graveolens* in habit, but the leaves are broader, more tomentulose; the bracts are slightly tomentulose, erose-ciliate, and broader than in that species. Ward's specimens were determined by Dr. Gray as *Bigelovia graveolens latisquamea* and included therein in the Synoptical Flora; but it is wholly distinct therefrom. The true *C. latisquamea* (A. Gray) Greene has very white filiform-revolute leaves and the bracts more rounded at the apex.

UTAH: Strawberry Valley, Sept. 3, 1883, *F. E. Leonard 288* (type, in herb. N. Y. Bot. Gard.); Twelve-mile-Creek, Aug. 29, 1875, *L. F. Ward 659*.

Chrysothamnus stenolepis sp. nov.

Low shrub, 2–3 dm. high, somewhat spinescent; branches short, erect, glabrous or finely puberulent above; leaves narrowly lance-linear, 1–2 cm. long, 2–4 mm. wide, glabrous, scabrous-ciliate on the margins, convolute and somewhat twisted; inflorescence corymbiform, of few heads; involucres about 8 mm. long; bracts 4-ranked in 3 series, narrowly lanceolate, or the inner linear, acute, glabrous, keeled, somewhat viscid; corollas scarcely exceeding the involucre; lobes lanceolate, 2 mm. long; achenes hirsute-strigose.

This species is related to *Chrysothamnus viscidiflorus* and *C. glaucus*, but differs from both in the very narrow acute bracts.

MONTANA: Pass Creek, near Bridger Pass, *H. Engelmann* (type, in herb. Columbia Univ.).

UTAH: Saleratus River, Aug. 1889, *C. K. Dodge*.

Chrysothamnus marianus sp. nov.

Undershrub, 1–2 dm. high, with a woody thick caudex; branches erect, at first green, soon straw-colored or white, densely and finely puberulent; leaves linear or the lower linear-oblanceolate, acute, thick, densely puberulent, 1–2 cm. long, 1–15 mm. wide, 1-nerved, somewhat twisted; heads narrow, in small, corymbiform-cymose panicles, involucres about 5 mm. high; bracts yellowish, glutinous, erose-ciliate on the margins, 4-ranked and in about 3 series, the outer ovate, acutish, the inner spatulate-oblong, rounded at the apex; achenes sparingly strigose; corollas scarcely exceeding the involucres.

This species has many characters of *Chrysothamnus puberulus*,

but differs in the more yellowish-green herbage, the whiter stems, the narrower, more erect, thick, 1-nerved instead of 3-nerved leaves, the finer pubescence, and the involucres, which are narrower and with different bracts. In *C. puberulus* the inner bracts are linear or linear-lanceolate and acute. The young achenes are only slightly strigose, in which respect it approaches *C. Bakeri* and *C. Vaseyi*.

UTAH: Along Sevier River, below Marysvale, July 20, 1905, *Rydberg & Carlton 6993* (type, in herb. N. Y. Bot. Gard.); also *6983*; Mount Barette, July 26, *7253*.

SOLIDAGO MISSOURIENSIS Nutt. Jour. Acad. Phila. 7: 32. 1834

Solidago Tolmieana A. Gray, Syn. Fl. 1[1]: 151. 1884.

Dr. Gray in the original publication of *S. Tolmieana* adds the following note: "Has been taken for a form of *S. missouriensis* var. *montana*;" but he overlooked the fact that it was identical with the original *S. missouriensis*. He might have been led astray by Nuttall himself, who later included in *S. missouriensis* the common plant of the upper Missouri Basin with recurved secund branches. That the latter is not the original *S. missouriensis* may be seen from Nuttall's diagnosis, of which I here give a copy:

"55 SOLIDAGO * *missouriensis*. Pumila, glabra, racemis erectis, foliis lineari-lanceolatis, acutis, inciso-subserrulatis, superioribus integris, panicula brevi laxa, floribus majusculis."

"Stem slender, smooth, leafy, about a foot or so high. Leaves scabrous at the margin. Panicle about three inches long, the branches slender, the flowers pedicellate, and brought together in a somewhat rhomboidal raceme. Rays as long as the calyx."

This agrees with *S. Tolmieana* but not with the plant described by Gray as *S. missouriensis*.

The original *Solidago missouriensis* was collected by Wyeth on the upper branches of the Missouri. There is a specimen of this collection in the Torrey Herbarium which agrees with the description and this matches very well the type of *S. Tolmieana* in the Gray Herbarium. The plant described by Gray as *S. missouriensis* is characterized by its flat-topped or round-topped inflorescence with recurved-spreading, secund branches, in variance with Nuttall's characterization: "racemis *erectis*," and "the flow-

ers pedicellate, and *brought together* in a somewhat rhomboidal *raceme*." The synonymy of Gray's plant is as follows:

SOLIDAGO GLABERRIMA Martens, Bull. Acad. Brux. **8**: 68. 1841

Solidago missouriensis Nutt. Trans. Am. Phil. Soc. II. **7**: 327, in part. 1840. Not *S. missouriensis* Nutt. 1834.
Solidago missouriensis A. Gray, Syn. Fl. **1**^{2}: 155. 1884.
Solidago serotina Hook. Comp. Bot. Mag. **1**: 97. 1835. Not *S. serotina* Ait. 1789.

Solidago glaucophylla sp. nov.

Perennial, with a branching rootstock; stems slender, pale, glabrous up to the sparingly pubescent inflorescence; leaves glabrous, glaucous, minutely ciliolate on the margins, rather thick, linear-oblanceolate or the upper linear, triple-nerved, 6–10 cm. long, 4–10 mm. wide, entire, acute; inflorescence a round-topped panicle, the branches somewhat recurved-spreading and somewhat secund; heads about 5 mm. high; bracts oblong, obtuse, or the outer lance-oblong, acutish; rays short, 2–2.5 mm. long, 0.7–0.8 mm. wide; achenes slightly strigose-hirsute.

This species is related to *Solidago missouriensis* and *S. glaberrima*, but differs from both in the narrow, entire, glaucous leaves and the thicker, oblong and obtuse instead of linear-lanceolate and acute bracts. The type grew on dry plains at an altitude of 1000 m.

MONTANA: Dry plains near Kalispel, Flathead Valley, July 25, 1901, *MacDougal 760* (type, in herb. N. Y. Bot. Gard.).

WYOMING: Buffalo, July 25, 1896, *A. Nelson 2501* (?, similar but with narrower inflorescence).

Solidago nivea sp. nov.

Perennial, with a woody cespitose rootstock and short caudex; stems 1–2 dm. high, decumbent at the base, canescent-puberulent; basal leaves 2–4 cm. long, short-petioled; blades obovate-spatulate, rounded at the apex, entire or nearly so; stem-leaves oblanceolate, sessile, the upper acutish; all leaves thick, densely canescent-puberulent, almost velvety and almost white; inflorescence a flat-topped corymbiform panicle; heads slightly nodding at first, but not secund on the branches, about 6 mm. high;

bracts yellowish with a greenish midrib, lanceolate and acute; achenes hirsute-strigose; ligules 3 mm. long and nearly 1 mm. wide.

This is closely related to *Solidago nana*, but differs in the narrower, lanceolate, and acute bracts. Its pubescence is usually also denser and whiter. Platt's specimens were labeled *S. missouriensis* v. *montana* Gray, to which it has no relationship, only resembling it a little in habit and in the narrow bracts.

MONTANA: Lima, Aug., 1905, *Rydberg 2804* (type, in herb. N. Y. Bot. Gard.); Hot Sulphur Springs, July 24, 1871, *W. B. Platt.*

Solidago Garrettii sp. nov.

Perennial, with a creeping rootstock; stem 2–3 dm. high, sparingly puberulent or glabrous; leaves obovate-spatulate or the upper oval, entire or the lower toothed towards the apex, rather thin, triple-nerved, minutely and sparingly scabrous-puberulent or nearly glabrate, scabrous-ciliolate on the margins, 3–6 cm. long; inflorescence more or less leafy, with a few secund branches; heads 5–6 mm. high; bracts lanceolate, acute, yellowish; ligules 2 mm. long and fully 0.5 mm. wide, golden yellow; achenes sparingly hirsute.

This species is related to *Solidago mollis*, *S. radulina*, and *S. Radula.* It differs from the first in the thinner, green, more decidedly obovate, and sparingly pubescent leaves, and the open, few-branched panicle; from *S. radulina* in the larger, thinner leaves, the open and more leafy inflorescence, and the acute instead of obtuse bracts; and from *S. Radula* in the thin, broad leaves, large, ample upper stem-leaves, the small inflorescence, and acute bracts.

UTAH: Big Cottonwood Cañon, Aug. 28, 1906, *A. O. Garrett 2041* (type, in herb. N. Y. Bot. Gard.); same locality and collector, Aug. 14, 1905, *1608*, and Aug. 5, 1905, *1587*.

WYOMING: Headwaters of Cliff Creek, Aug. 9–18, 1900, *C. C. Curtis.*

ASTER RICHARDSONII Sprengel, Syst. **3**: 528. 1826

Aster montanus Richards. App. Frankl. Journ. 749. 1823. Not *A. montanus* Nuttall. 1818.

Aster salsuginosus Less. Linnaea **6**: 124. 1831. Not *A. salsuginosus* Richards. 1823.

Aster Richardsonii, var. *gigantea* Hook. Fl. Bor.-Am. **2**: 7. 1834.
Aster sibiricus giganteus A. Gray, Syn. Fl. **1**^{2}: 177. 1884.
Aster giganteus Rydb. Bull. N. Y. Bot. Gard. **2**: 184. 1901.

In describing *Aster meritus*,* Professor Aven Nelson evidently was correct in referring the name *A. Richardsonii* Spreng. to the subarctic species, characterized by the densely villous peduncles and involucres, which the writer has named *A. giganteus*. Richardson collected both, as shown by specimens in the Columbia University herbarium, and evidently included both under the name *A. montanus*, but his description applies only to the plant which Hooker afterwards named and described as *A. Richardsonii*, var. *gigantea*. There are, however, two points in Professor Nelson's discussion which are a little erroneous, ambiguous, and unclear, wherefore I add the following.

Professor Nelson has made the following remarks: "It is equally clear that *A. Richardsonii* is the name given to the *A. montanus* Nutt." If this was true, *A. Richardsonii* should be a synonym of *A. sericeus montanus* of the Southern States, and I received that impression when I read Professor Nelson's discussion. Evidently this was not Professor Nelson's intention. He evidently meant *A. montanus* Richardson.

From Professor Nelson's discussion, one also gets the impression that *A. meritus* Nels. is not found in the subarctic regions, and is a plant of the Rocky Mountains only, but this is not the fact. The specimens regarded as *A. Richardsonii* by Hooker and cited in his Flora, as collected in the "barren country from lat. 64° to the Arctic Seas" belong to *A. meritus*. Two of Richardson's specimens are in the herbarium of Columbia University. These cannot be distinguished from Nelson's *nos. 2334* and *6610* cited under *A. meritus*.

As said before, Richardson collected both plants. Hooker was the first one to distinguish them and made one the species, the other the variety of *A. Richardsonii* Spreng., as *A. montanus* Richardson was not available on account of the older *A. montanus* Nutt., *A. Richardsonii* Spreng. being only a substitute for the former. Under ordinary circumstances, we should have followed Hooker's interpretation and used *A. Richardsonii* for the short-pubescent

* Bot. Gaz. 37: 268. 1904.

plant. The writer made such a ruling in 1901, when he raised *A. Richardsonii*, var. *gigantea* to specific rank. But it is evident from Richardson's description that his *A. montanus* characterized rather the more villous-tomentose plant. Not only was Sprengel's *A. Richardsonii* based upon *A. montanus* Richardson, but his description also characterizes Hooker's var. *gigantea*.

The synonymy of the more southern plant is as follows:

ASTER MERITUS A. Nelson, Bot. Gaz. **37**: 269. 1904

Aster montanus Richardson, App. Frankl. Journ. 32, in part (?). 1823.

Aster Richardsonii Hook. Fl. Bor.-Am. **2**: 7. 1834. Not *A. Richardsonii* Spreng. 1826.

Aster sibiricus A. Gray, Syn. Fl. $\mathbf{1}^2$: 176. 1884. Not *A. sibiricus* L. 1753.

Aster Williamsii sp. nov.

Perennial, with cespitose rootstock; stems erect, about 3 dm. high, more or less villous; leaves oblanceolate, 3–10 cm. long, the lower petioled, the upper sessile, finely villous on both sides; heads few in a corymbiform inflorescence; involucres 8 mm. high, 1 cm. broad; bracts linear or lance-linear, acute, sparingly and finely villous on the back, slightly scarious-margined below, imbricate in 3 series; rays lilac, about 1 cm. long; achenes sparingly and finely pilose; pappus tawny.

This species is somewhat intermediate between *Aster andinus* and *A. meritus*. From the former it differs in the taller and more slender, erect stem, the finely villous leaves, the shorter, more numerous and more pubescent involucral bracts; and from the latter in the narrower leaves, which are always entire, in the comparatively higher involucre, and the narrower bracts.

WYOMING: Dry hills, North Fork of Clear Creek, Big Horn Mountains, Aug. 12, 1898, *T. A. Williams* (type, in herb. N. Y. Bot. Gard.); eastern slope of Big Horn Mountains, headwaters of Clear Creek and Crazy Woman River, July 20–Aug. 15, 1900, *Tweedy 3096A*.

Aster Macounii sp. nov.

Perennial, with a rootstock; stem 3–6 dm. high, sparingly hispid-strigose, purple-tinged; leaves thick, oblanceolate or lanceolate, 2–8 cm. long, hispidulous-ciliate, otherwise glabrous; in-

florescence corymbiform; heads solitary on branches with lanceolate bract-like leaves; involucre 8–10 mm. high, 12–15 mm. broad; bracts oblanceolate, squarrose, acute and spinulose-tipped, pubescent on the back and ciliate on the margins; rays 7–8 mm. long, rose-colored; achenes strigose, pappus pinkish tawny.

This species combines the characters of two different groups of asters. It has the habit, leaves, middle-sized heads, pappus, and pubescence of the bracts of *Aster Nelsonii*, *A. griseus*, and their allies, but has the spinulose- or callus-tipped bracts and upper leaves of *A. multiflorus*, *A commutatus*, etc.

CANADA: Old Wives Lake, Northwest Territory [Keewatin], July, 1880, *John Macoun* (type, in herb. Columbia Univ.).

ASTER LINDLEYANUS T. & G. Fl. N. Am. **2**: 122. 1841

Aster paniculatus, var. δ Lindl. in Hook. Fl. Bor.-Am. **2**: 8. 1834.

Dr. Gray in his Synoptical Flora* stated: "The original of this species was raised by Gordon from Labrador seeds and has more extended inflorescence of smaller heads than is common in the wild plant." Dr. Gray evidently referred to *Aster paniculatus* Ait.;† however, *A. Lindleyanus* was not based on *A. paniculatus* Ait., but principally on *A. paniculatus*, var. δ of Lindley in Hooker's Flora, although *A. paniculatus* of the same work was partly included. The var. δ was collected by Richardson near Slave Lake. Whether this plant is the same as *A. paniculatus* Ait. is very doubtful. *Aster Lindleyanus* has been reported from many stations in eastern North America as far south as Ohio, but the eastern plant differs somewhat from that of the Mackenzie basin and the northern Rockies in thinner more decidedly cordate basal leaves, and in its bracts with more conspicuous green tips. As these differences are hardly specific it is best to leave the eastern plant in *A. Lindleyanus*. In the northern Rockies and the Saskatchewan region there are found plants which have been referred to *A. Lindleyanus* but which the writer thinks are distinct. They can be distinguished as follows:

Basal leaf-blades cordate or broadly ovate; upper stem-leaves lanceolate; achenes glabrous.
  Petioles, midribs, and usually also the stem pubescent with long white hairs.. *A. Wilsonii.*

* 1^2: 182. 1884.
† Hort. Kew. **3**: 207. 1789.

Plant glabrous or sparingly short-pubescent.......................... *A. Lindleyanus.*
Basal leaf-blades lanceolate; upper stem-leaves narrowly lanceolate or those of the inflorescence lance-linear.
Heads few; involucres 8–9 mm. high; rays about 15 mm. long; achenes glabrous.. *A. MacCallae.*
Heads numerous; involucres 5–6 mm. high; rays 8–10 mm. long; achenes hispidulous-strigose.................................. *A. Butleri.*

Aster Wilsonii sp. nov.

Aster Lindleyanus β T. & G. Fl. N. Am. **2**: 122. 1841.

Perennial, with a horizontal rootstock; stem 3–6 dm. high often purplish, more or less pubescent with long white, curved, somewhat deciduous hairs; basal leaves petioled; petioles 5–10 cm. long, densely white-ciliate, together with the midrib; blades ovate or subcordate, 5–10 cm. long, usually more or less hirsute on both sides, but in age glabrate, serrate, acuminate at the apex; the lower stem-leaves similar; the upper lanceolate, sessile, subentire or those of the paniculate inflorescence narrowly lanceolate; involucre 7–8 mm. high, scarcely 1 cm. wide; bracts subulate, attenuate, with a green midrib which widens somewhat above the middle; rays 8–10 mm. long, bluish purple; pappus tawny; achenes glabrous.

This species is related to *Aster Lindleyanus* and may grade into it, but the typical specimens are very distinct, characterized by the long white hairs on the petioles, midribs, and often the stem, by the narrower upper leaves, the smaller heads, and the more ascending branches.

BRITISH COLUMBIA: Armstrong, 1904, *E. Wilson 419* (type, in herb. N. Y. Bot. Gard.); also *414*, *416*, and *393*.

ALBERTA: Grattan Creek, Aug. 16, 1906, *Macoun & Herriot 77073;* also Edmonton, Aug. 26, 1906, *77074*.

WESTERN ONTARIO: Fort Williams, Sept. 7, 1889, *Dr. and Mrs. N. L. Britton and Miss Millie Timmerman.*

MACKENZIE: Fort Resolution and Mackenzie River, 1861–2, *R. Kennicott.*

Aster MacCallae sp. nov.

(?) *Aster praecox* Lindl. in Hook. Fl. Bor.-Am. **2**: 9. 1834. Not *A. praecox* Willd. 1813.

Perennial, with a horizontal rootstock; stems 3–6 dm. high, often purplish, glabrous up to the inflorescence, the branches of which are slightly pubescent in lines; lower leaves with winged

petioles, which are slightly dilated and ciliate at the base; blades broadly lanceolate, 8–15 cm. long, usually more or less serrate with ascending teeth, acute, glabrous or essentially so, hispidulous-ciliolate on the margins, rather thick; upper leaves lanceolate, sessile or those of the inflorescence lance-linear; inflorescence or its few principal branches racemiform; involucres 8–9 mm. high, 1 cm. broad; bracts subulate, glabrous, with linear-lanceolate green tips and green midveins below; rays blue or bluish purple, about 15 mm. long; disk-flowers red-purple; achenes glabrous, at least in age.

This may be the *A. praecox* of Hooker's Flora Boreali-Americana; but the name is preoccupied by *A. praecox* Willd. It is related to *A. Lindleyanus*, but differs in the narrower leaves, of which the lower are neither cordate nor broadly ovate and those of the inflorescence are lance-linear, in the larger rays, which are about 15 mm. long, and in the more ascending branches of the simpler inflorescence.

ALBERTA: Along streams, edge of woods on the Sulphur Mountain, Aug. 16, 1899, *McCalla 2026* (type, in herb. N. Y. Bot. Gard.); roadside, Spray Avenue, Banff, Sept. 18, 1899, *McCalla 2027;* below Wapta Lake, Aug. 6, 1904, *J. Macoun 69480;* gravelly banks, Second Lake, Rocky Mountain Park, Aug. 3, 1891, *Macoun 7770.*

Aster Butleri sp. nov.

Perennial, with a horizontal rootstock; stem 4–10 dm. high, glabrous, slender; lower leaves petioled; blades lanceolate, about 1 dm. long, distantly serrate with ascending teeth, hispidulous-ciliolate on the margins, otherwise glabrous; upper stem-leaves sessile, narrowly lanceolate, or those of the inflorescence lance-linear, entire; inflorescence paniculate with numerous heads; involucres 5–6 mm. high. about 8 mm. wide; bracts subulate, with green midribs and narrowly lanceolate green tips, attenuate, glabrous; rays bluish purple, 8–10 mm. long; achenes hispidulous-strigose.

This is related to the preceding, but differs from it in the large inflorescence with numerous small heads, and in the pubescent achenes. In the latter respect it differs from all the species of the *Aster Lindleyanus* group.

MONTANA: Gateway, Aug. 16, 1908, *B. T. Butler 443* (type, in herb. N. Y. Bot. Gard.); also *433*.

ALBERTA: Field, Aug. 28, 1904, *J. Macoun 65485*.

BRITISH COLUMBIA: Flood plains of Columbia at Beavermouth, Aug. 18, 1905, *C. H. Shaw 1165*; Armstrong, 1904, *E. Wilson 422* (?); Emerald Lake, Aug. 30, 1904, *J. Macoun 65488* (in part).

Aster subsalignus sp. nov.

Perennial, with a rootstock; stem glabrous throughout, 6–10 dm. high; leaves nearly erect, glabrous, glaucous, entire, clasping but scarcely auricled, 5–10 cm. long, narrowly linear, 6–7 mm. wide, or the lower narrowly linear-oblanceolate, or those of the branches lance-linear and reduced; inflorescence paniculate; involucres about 7 mm. high and 8 mm. wide; bracts linear or the outer linear-lanceolate, glabrous, acute, with a green midrib and narrowly lanceolate green tip, or the outer nearly wholly green; rays bluish or bluish purple, about 8 mm. long; achenes glabrous; pappus tawny; disk-flowers dark, red-purple.

This is related to *Aster Geyeri*, but differs in the narrow leaves, scarcely auricled at the base; they are also more erect or strongly ascending and wholly entire. It stands in the same relation to *Aster Geyeri* as *A. virgatus* and *A. concinnus* do to *A. laevis*. It has the narrow green tips of the bracts found in *A. Geyeri* but not in the others. The spreading branches of the inflorescence with their very small bract-like leaves characteristic of the three are not found in this species, and scarcely in *A. Geyeri*.

COLORADO: Glenwood Springs, Aug. 18, 1906, *G. E. Osterhout 3397* (type, in herb. N. Y. Bot. Gard.).

ASTER WOOTONII Greene, Leaflets **1**: 146. 1905.

Aster hesperius Wootonii Greene, Bull. Torrey Club **25**: 119. 1898.

In raising the variety to specific rank, Dr. Greene stated: "Mr. Baker's n. 817 from near Gunnison represents well that of Mr. Wooton's distribution from New Mexico, and I judge the form worthy of specific rank." In the herbarium of the New York Botanical Garden there are duplicates of both *Baker 817* and *Wooton 329*, the latter the type of *A. hesperius Wootonii*. The two are not the same. The latter has the subequal loose bracts and entire leaves of *A. hesperius*, and is best referred to that species; in fact it matches very closely *Wright 1158*, which number I take to be the type of *A. hesperius*. In the former the bracts are well

imbricated in 3 or 4 unequal series and the leaves are distinctly dentate and it agrees in every respect with specimens of *A. paniculatus.* In the writer's judgment it is nothing but the not uncommon pinkish- or light lilac-flowered form of that species.

Aster roseolus sp. nov.

Perennial, with a horizontal rootstock; stem 3–5 dm. high, often purple-tinged, glabrous, pilose in lines on the branches; leaves linear, glabrous or nearly so, scabrous-ciliolate on the margins, 5–10 cm. long, 5–12 mm. wide, inflorescence paniculate but the heads usually few; involucres about 5 mm. high, 8–9 mm. broad; bracts glabrous, oblong or oblong-linear, acute, in about 3 series, often wholly green, with broadly lanceolate tips; rays rose-colored, 5–6 mm. long; achenes hispidulous-strigose.

This species is related to *Aster longulus* and *A. Tradescanti,* but differs in the bright rose-colored rays, the less numerous heads, simpler plant, and broader leaves. It grows in meadows at an altitude of 1500–2000 m.

MONTANA: Melrose, 1895, *Rydberg 2817* (type, in herb. N. Y. Bot. Gard.); Lima, Aug. 5, 1895, *Rydberg;* Logan, July 28, 1895, *Shear 5253;* Emigrant Gulch, Aug. 23, 1897, *Rydberg & Bessey 5121.*

Aster Franklinianus Rydb. nom. nov.

Aster salicifolius Richardson, in Frankl. Journ. 748. 1823. Not *Aster salicifolius* Lam. 1783.

Aster laxiflorus Lindl. in Hook. Fl. Bor.-Am. **2**: 10, mainly. 1834. Not *Aster laxiflorus* Nees. 1833.

Aster laxiflorus borealis T. & G. Fl. N. Am. **2**: 138, in part. 1841.

Dr. Gray referred this to *Aster junceus* but it is more closely related to *A. longifolius*, having the subequal bracts and the dark green leaves of that species, but the bracts are narrower and strictly appressed and the leaves are very narrowly linear and as far as I know perfectly entire. It is *A. laxiflorus* of Lindley mainly but he included a specimen of Mrs. Percival's from eastern Canada (apparently of *A. junceus*), and this very specimen is the type of *A. laxiflorus borealis* T. & G. Otherwise the species would have become *A. borealis* Prov., as Provancher raised the variety to specific rank. He also characterized the eastern plant. The following specimens belong to *A. Franklinianus:*

MACKENZIE TERR.: Slave Lake, *Richardson;* Wooded Country, *Richardson;* Mackenzie River 1861–2, *Kennicott;* Fort Resolution, 1861–2, *Onion, Kennicott & Hardisty.*

SASKATCHEWAN: 1857–8, *E. Bourgeau.*

MONTANA: Gateway, Aug. 17, 1908, *Butler 477, 473,* and *434;* Helena, Aug. 16, 1892, *Kelsey.*

Aster junciformis sp. nov.

Aster junceus Coulter, Man. 161, in part. 1885.

Aster longulus Rydb. Fl. Colo. 356. 1906. Not *Aster longulus* Sheldon. 1894.

Perennial, with a slender horizontal rootstock; stem slender, 3–5 dm. high, simple below, with pilose lines or wholly glabrous below; leaves narrowly linear, 4–8 cm. long, 2–4 mm. wide, scabrous-ciliolate on the margins, light green; inflorescence corymbiform, with the rather few heads terminating the stem and leafy branches; involucres about 6 mm. high, about 1 cm. broad; bracts glabrous, erose-ciliolate; the inner bracts linear, acute, with green midrib and green lanceolate tips, the outer oblong or somewhat oblanceolate, obtuse, and often almost wholly green; rays white, 6–8 mm. long; achenes sparingly hairy or nearly glabrous.

This has been known under the name of *A. junceus* in nearly all western botany, but differs in the always white rays, the subcorymbose inflorescence, and the broader bracts. In the eastern *A. junceus* the bracts are narrowly linear or linear-subulate and the rays are always described as light purple.

MONTANA: East Gallatin Swamps, July 24, 1896, *Flodman 833* (type, in herb. N. Y. Bot. Gard.).

NORTH DAKOTA: Butte, Aug. 5, 1906, *Lunell.*

SOUTH DAKOTA: Custer, Aug. 15, 1892, *Rydberg 775.*

COLORADO: West Cliff, 1896, *Shear 3463, 3817;* Twin Lakes, *Clements 388* and *379.*

MINNESOTA: Minneapolis, 1891, *G. B. Aiton;* Hennepin County, 1890, *Sandberg.*

SASKATCHEWAN: Cypress Hills, 1880, *J. Macoun;* Lake Manitou, July 23, 1906, *Macoun & Herriot 77052;* also Bear Hills, July 29, *77051.*

ALBERTA: Five miles west of Battle River, 1906, *Macoun & Herriot 77053;* also Grattan Creek, Aug. 16, *77050.*

BRITISH COLUMBIA: Swamps at Gold Stream, Aug. 3, 1905, *Shaw 1081.*

Aster eriocaulis sp. nov.

Perennial, with a rootstock; stems about 8 dm. high, leafy, more or less villous, especially above, purplish; stem-leaves lanceolate, 3–7 cm. long, ciliolate on the margins, otherwise glabrous, more or less auriculate-clasping; inflorescence a round-topped panicle; involucres 8 mm. high, 10–12 mm. broad; bracts linear, acute, more or less ciliate, in 2–3 series, with green midrib and lanceolate green tips, or the outermost almost wholly green; rays purple, 8–10 mm. long; achenes sparingly hirsute-strigose.

This species is perhaps most nearly related to *Aster lonchophyllus* but differs in the longer villous pubescence of the stem, the more or less clasping leaves, less imbricated and not purple-tinged bracts. In general habit and leaf-form it resembles somewhat *A. Jessicae,* but differs in the glabrous leaves and narrower glabrous bracts.

IDAHO: Mountain meadows, valley of Traille River, Kootenai County, Aug. 9, 1892, *Sandberg, MacDougal, & Heller 877* (type, in herb. N. Y. Bot. Gard.).

Aster subcaudatus sp. nov.

Perennial, with a creeping rootstock; stem 3–6 dm. high, more or less purple, glabrous below, with villous or pilose peduncles and lines above; lower leaves petioled, 1–2 dm. long; blades lanceolate, 4–10 cm. long, often sparingly dentate with ascending sharp teeth, dark green, glabrous, ciliolate on the margins; upper leaves sessile, linear-lanceolate, attenuate; panicle open, with rather few heads; involucres 7–8 mm. high, about 12 mm. broad; bracts linear-subulate, in 2 or 3 series, but nearly of the same length, attenuate, the inner almost caudate, only slightly white-margined below; rays purple, about 1 cm. long; achenes nearly glabrous.

The type was determined as *Aster Fremontii* (?), but is evidently distinct; differing from that species as well as its relatives, *A. occidentalis, A. ciliomarginatus,* etc., in the narrow attenuate bracts. It is also a taller plant with a tendency to having dentate leaves. If one should use Piper's key in his Flora of Washington it would fall under *A. occidentalis* Nutt. The latter, as described in Gray's Synoptical Flora, has well-imbricated bracts, of which the outer are shorter; but neither the present species nor Gray's

Xylorrhiza lanceolata sp. nov.

Shrubby perennial, with white stems; branches more or less villous; leaves lanceolate, 4–6 cm. long, more or less villous, especially when young, reticulately veined, dentate with spinulose-subulate teeth, which are directed forward and then falcately curved outward; peduncles 1–2 dm. long; involucre fully 1 cm. high, 15–20 mm. broad; bracts lance-subulate, villous and slightly glandular, attenuate and spinulose-tipped, the inner about equaling the disk, a few of the outer ones often longer and squarrose; rays purple, about 2 cm. long; achenes hirsute; pappus brownish tawny.

This is related to *Xylorrhiza tortifolia* (T. & G.) Greene, but differs in the broader leaves and their teeth. In *X. tortifolia*, the body of the leaves is linear or narrowly linear-lanceolate, the teeth are shorter and broader and diverge at almost right angles to the midrib; the outer bracts are neither elongated nor spreading.

UTAH: St. George, 1877, *Palmer 208* (type, in herb. Columbia Univ. and N. Y. Bot. Gard.); South Utah, 1875, *J. E. Johnson*; 1874, *C. C. Parry 91* (?).

Unamia alba (Nutt.) Rydb. comb. nov.

Inula (*Chrysopsis*) *alba* Nutt. Gen. **2**: 152. 1818.
Aster albus Eat. Man. Bot. 127. 1829. Not *Aster albus* Willd. 1826.
Doellingeria ptarmicoides Nees, Gen. & Sp. Ast. 183. 1833.
Chrysopsis alba Nutt.; Nees, Gen. & Sp. Ast. 183, as a synonym. 1833.
Diplopappus albus Hook. Fl. Bor.-Am. **2**: 21. 1834.
Heliastrum album DC. Prod. **5**: 264. 1836.
Encephalus albus Nutt. Trans. Am. Phil. Soc. II. **7**: 299. 1840.
Aster ptarmicoides T. & G. Fl. N. Am. **2**: 160. 1841.
Unamia ptarmicoides Greene, Leaflets **1**: 6. 1903.

From the various disposition which has been made of this plant, it is evident that the species has been out of place in all the genera to which it had been referred. I therefore agree with Dr. Greene that it represents the type of a distinct genus. Unfortunately Dr. Greene did not use the first available specific name, which is here accepted. Usually the original publication is given as *Chrysopsis alba* Nutt. Gen. **2**: 152. 1818. In that work

Nuttall, however, did not publish it as *Chrysopsis* but as *Inula*, *Chrysopsis* being only a subgeneric name. The Kew Index cites DC. Prod. (*l. c.*) as the place of publication of the combination *Chrysopsis alba*, but it appeared at least one year earlier in Nees's Genera. In describing the genus *Unamia*, Dr. Greene stated: "And that the bristles of the pappus are visibly dilated at the tip is a character, here for the first time noted." This appears to be not quite the fact, for we find in the sectional description in Torrey & Gray's Flora: "the longer bristles clavellate-thickened at the apex;" and in Gray's Synoptical Flora: "pappus white, of rather rigid bristles, longer ones manifestly clavellate at tip." The expressions used by these authors are even more characteristic than Greene's description, for the pappus-bristles are by no means flattened, as the word "dilated" usually implies.

Unamia lutescens (Lindl.) Rydb. comb. nov.

Diplopappus albus β Hook. Fl. Bor.-Am **2**: 21. 1834.
Diplopappus lutescens Lindl.; DC. Prod. **5**: 278. 1834.
Aster lutescens T. & G. Fl. N. Am. **2**: 160. 1841.
Aster ptarmicoides lutescens A. Gray, Syn. Fl. **1**^{2}: 199. 1888.

The color of the rays, yellow or ochroleucous as it has been described, is probably of little value specifically and may vary; but in the specimens seen the bracts are "very obtuse" as described in Torrey & Gray's Flora, the inner even rounded at the apex and therefore different from those of the typical *U. alba*. The range of this species seems to be more restricted than that of *U. alba*, extending from Illinois and Wisconsin to Saskatchewan.

Doellingeria pubens (Gray) Rydb. sp. nov.

Aster umbellatus pubens A. Gray, Syn. Fl. **1**^{2}: 197. 1884.

This I think specifically distinct from *D. umbellata* (Mill.) Nees.

Machaeranthera angustifolia nom. nov.

Machaeranthera linearis Rydb. Mem. N. Y. Bot. Gard. **1**: 398. 1900. Not *M. linearis* Greene. 1897.

Machaeranthera leptophylla sp. nov.

Biennial, cespitose at the base; stems slender, simple up to the inflorescence, green, sparingly puberulent, 3–5 dm. high;

lower leaves petioled, 2–5 cm. long, finely cinereous-puberulent, in age sparingly so; blades spatulate or oblanceolate, entire or sparingly dentate, thin; upper leaves linear-oblanceolate or linear, entire; branches strongly ascending; involucre turbinate, 8 mm. high, 8–10 mm. broad; bracts in 6 or 7 series, linear, acute; green tip short, glandular-puberulent, much shorter than the chartaceous portion, only slightly squarrose; rays rose-purple, about 8 mm. long; achenes finely strigose.

This agrees fairly well with the description of *M. laetevirens* Greene, except that the plant is evidently cinereous-puberulent.

UTAH: Logan, Aug. 9, 1895, *Rydberg* (type, in herb. N. Y. Bot. Gard.).

NEW YORK BOTANICAL GARDEN.

Studies on the flora of Southern California — III

LE ROY ABRAMS

Lepidium bernardinum sp. nov.

Root stout, perpendicular; stem simple below, branched above, or in small specimens simple, 4–6 dm. high, pubescent below with short, deflexed hairs, puberulent above; basal leaves oblanceolate, the blade toothed, 3–5 cm. long, tapering to a slightly longer, somewhat winged petiole, pubescent; petiole ciliate on the margin; stem-leaves narrowly oblanceolate, sessile, pubescent, toothed, those of the ultimate branches becoming entire and nearly linear; sepals slightly exceeding 1 mm. in length; petals oblanceolate, scarcely equaling the sepals; silicels glabrous, 3.5 mm. broad, orbicular or slightly longer than broad, on slender, puberulent, widely spreading, terete pedicels, which are about 5 mm. long; cotyledons incumbent.

A near relative of *Lepidium medium*, but readily distinguished by its pubescence, broader leaves, and larger silicels.

Lepidium bernardinum is common in the coniferous forests of the southern California mountains. The type, which is deposited in the herbarium of the New York Botanical Garden, was collected by the writer (*2826*) in Bear Valley, San Bernardino Mountains, July, 1902.

Cercocarpus minutiflorus sp. nov.

Shrub 2–2.5 meters high, with herbage glabrous throughout; leaves obovate, cuneate at base, serrate-toothed on the rounded summit, 1–2 cm. long, green and shiny beneath, thin; veins 3 or 4 pairs; petioles 4 mm. long; pedicels slender, 7 mm. long; calyx-tube 12 mm. long (in young fruit), 1 mm. broad; calyx-limb 2 mm. broad, minutely and very sparsely tomentulose, its lobes subulate-triangular.

The small bright green leaves distinguish this species at once in the field. The minute calyx-limb with its almost subulate lobes are, also, quite unlike the silky-tomentose calyx-limb and broadly triangular lobes of *C. betulaefolius.*

This species belongs to the chaparral belt of southwestern San Diego County, where it seems wholly to replace *C. betulaefolius.*

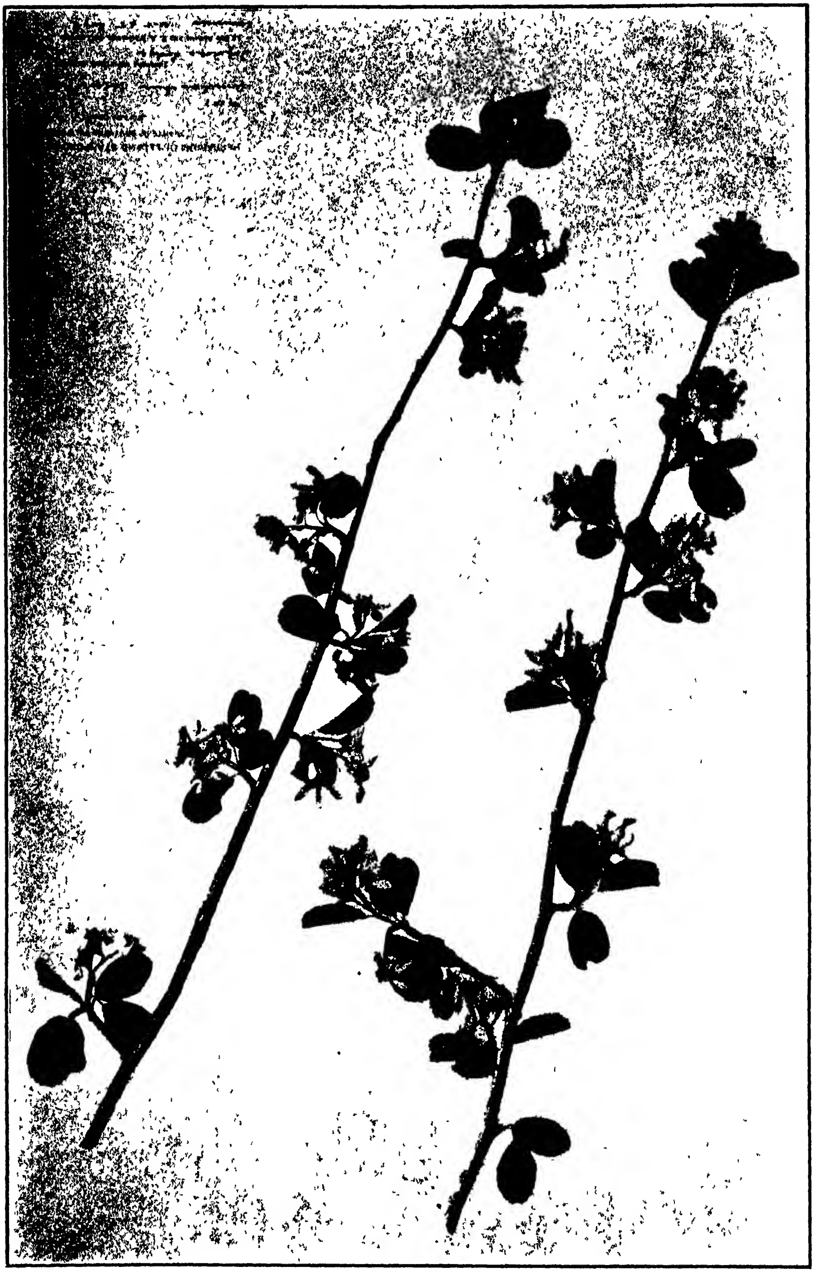

FIGURE 1. Photograph of the type specimen of *Amelanchier recurvata* Abrams, about two fifths of its natural size.

The type was collected by the writer (*3376*) in dry chaparral-covered hills, near San Dieguito (Bernardo), May 4, 1903.

The type sheet of this species, as well as those of the following new species, is deposited in the herbarium of the Leland Stanford Jr. University.

Amelanchier recurvata sp. nov.

Low spreading shrub, 1–1.5 meters high; branches slender, spreading and more or less drooping, their bark reddish brown; leaves mostly broadly oblong, 15–25 mm. long, distinctly serrate on the rounded or truncate summit, sparsely tomentulose on both surfaces; veins in 7 or 8 pairs, prominent; petioles slender, 4–6 mm. long; racemes 4–7-flowered; pedicels nearly or quite glabrous, reddish; calyx glabrous without at flowering time, its lobes sharply acute, 3 mm. long, strongly recurved, villous within; petals oblanceolate, 10 mm. long, rounded at the apex, 3.5–4 mm. broad. [FIGURE 1.]

Amelanchier recurvata has the foliage aspect of *A. venulosa*, but is distinguished by its slender, spreading habit, its more glabrous foliage and inflorescence, and by its larger flowers.

Topatopa Mountains, altitude 5500 feet, Ventura County, *Abrams & McGregor 107*, June 4, 1908.

Lupinus Hallii sp. nov.

Shrubby, 6–10 dm. high; herbage canescent with a short appressed silky pubescence; leaflets 7–9, spatulate, 12–24 mm. long; petioles slender, 2.5–4.5 cm. long; peduncles 20–25 mm. long; flowers mostly in whorls 2–3 cm. distant; bracts ovate-lanceolate, acuminate, caducous, 7 mm. long; calyx-lobes 1 cm. long, the upper 2-lobed (lobe 2 mm. long), the lower 3-toothed; standard 15 mm. long, nearly orbicular; wings 15 mm. long, 8 mm. broad, completely enclosing the keel; keel strongly falcate, 5 mm. broad at the angle, conspicuously ciliate on the central part of the inner margins; pod about 4 cm. long, silky-pubescent, 5- or 6-seeded. [FIGURE 2.]

· Distinguished from *L. albifrons*, which seems to be confined to central California, by the size of the flower and the structure of the calyx. *L. albifrons* has petals scarcely 10 mm. long, the lower calyx-lobe entire, and the upper lobed to near the middle. The large size of the flower in *L. Hallii* is like that of *L. longifolius*, but the latter has much larger leaves, which are less silky-pubescent, and calyx-lobes of the *L. albifrons* type.

FIGURE 2. Photograph of the type specimen of *Lupinus Hallii* Abrams, about two fifths of its natural size.

Type collected in Reche Cañon, altitude 400 meters, San Bernardino County, *H. M. Hall*, May 15, 1901. *Parish 4772*, collected in the vicinity of San Bernardino, May, 1901, also belongs here.

Rhamnus pilosa (Trelease) Abrams, comb. nov.

Rhamnus crocea, var. *pilosa* Trelease; Curran, Proc. Cal. Acad. II. 1: 251. 1888.

A small arborescent shrub with grayish bark and pilose herbage; leaves broadly ovate or nearly orbicular, 15–30 mm. long, spinose-serrate; calyx of staminate flowers 3.6 mm. long, its lobes ovate-lanceolate, 1.7 mm. long; anthers 0.5 mm. long, nearly as broad; filaments scarcely dilated at base, nearly twice the length of the anthers; fruiting pedicels equaling the glabrous capsules.

This species, which was originally collected in the "Santa Maria Valley, in the mountains back of San Diego," is apparently confined to the San Diego district. It is nearest related to *Rhamnus ilicifolia*, but differs in the pilose herbage, the shorter and broader calyx-lobes, and the minute anthers, which are scarcely half the size.

STANFORD UNIVERSITY, CALIFORNIA.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1903-1908)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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BULLETIN

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The violets of Staten Island

Philip Dowell

(WITH PLATES 11–18)

This list of the native violets growing on Staten Island is the result of several years of intensive study of the plants in the field and in cultivation at home. In the case of some of the hybrid plants, their identity could be established only by thus keeping them under constant observation through at least one season; and so there may be found in violet collections a number of specimens that cannot be identified with any degree of certainty. A number of such specimens from Staten Island are not included in this list.

Violets in general grow well in cultivation, even in a small city lot, like my own garden, but a few do not thrive so well and are less easily grown. In general they retain in cultivation the same characters as in their natural habitat, but those transplanted from moist or shady woodlands have acquired more or less the character of the same species growing naturally in the open. A plant of *V. papilionacea*, for example, transplanted from the Emerson Hill woods, acquired the characteristics of the form that has been described as *V. domestica*.

Acknowledgments are due to Dr. E. Brainerd, to whom we owe so much of our present knowledge of violets, and who kindly examined my earlier collection of violets, and to Dr. Homer D. House, who has presented his extensive collection of violets to the Staten Island Association of Arts and Sciences and thus made it available for general study.

[The Bulletin for March, 1910 (37 : 97–162. *pl. 9, 10*) was issued 31 Mr 1910.]

Key to the Staten Island species of violets

I. *Acaulescent: leaves and flowers directly from underground stems*

Leaves lobed or deeply cut.
- Leaves parted into many slender radiating divisions; style not beaked. — 1. *V. pedata.*
- Leaves shallowly or deeply lobed, with a main middle part; style slightly beaked.
  - Plants not hairy, or but slightly so on the upper surface and margin of leaf; capsules green. — 2. *V. Brittoniana.*
  - Plants more or less hairy on leafstalks and flower stalks; capsules mottled with purple.
    - Leaves variable, slightly irregularly lobed or deeply parted. — 8. *V. palmata.*
    - Leaves, or some of them, three-lobed, the others not lobed. — 9. *V. triloba.*

Leaves not lobed.
- Petals blue or lavender.
  - Capsules green, on erect stalks.
    - Plants not hairy, or but slightly so on the upper surface and margin of leaf.
      - Leaves broad, pectinately toothed or regularly incised. — 3. *V. pectinata.*
      - Leaves broad, crenate, deeply cordate; seeds nearly black. — 4. *V. cucullata.*
      - Leaves triangular-ovate, truncate at base, with larger teeth at base. — 5. *V. emarginata.*
      - Leaves sagittate or oblong-ovate, narrower than in the preceding. — 6. *V. sagittata.*
    - Plants hairy, leafstalk usually not much longer than the blade. — 7. *V. fimbriatula.*
  - Capsules usually mottled with purple, on prostrate to ascending stalks.
    - Plants distinctly hairy on leafstalks, or with long hairs on the upper surface of leaf.
      - Flower stalks and leafstalks hairy. — 10. *V. sororia.*
      - Upper surface of leaf with rather long hairs, otherwise not hairy, plants low. — 11. *V. hirsutula.*
    - Plants not hairy, or only slightly so on upper surface and margin of leaf.
      - Leaves not deeply cordate; capsules often finely hairy, on ascending stalks; auricles of calyx ciliolate, seeds buff. — 12. *V. affinis.*
      - Leaves cordate, larger than in the preceding; capsules larger, never hairy; closed flowers at first prostrate; ripe seeds dark. — 13. *V. papilionacea.*
- Petals white, some streaked with purple; plants freely spreading by slender stolons.
  - Blade of leaf hairy on at least one surface.
    - Leaves hairy on the upper surface, otherwise nearly smooth. — 14. *V. blanda.*

Leaves not hairy on the upper surface, plant otherwise hairy.	15. *V. incognita.*
Blade of leaf not hairy on either surface.	
Blades rounded, cordate; seeds small, nearly black.	16. *V. pallens.*
Blades ovate to ovate-lanceolate; seeds larger, brown.	17. *V. primulifolia.*
Blades lanceolate to narrowly lanceolate; seeds dark brown.	18. *V. lanceolata.*
Petals yellow; leaves pale beneath, spreading close to the ground.	19. *V. rotundifolia.*

II. *Caulescent: with stems above ground bearing leaves and flowers*

Petals yellow.	
Plants decidedly hairy.	20. *V. pubescens.*
Plants not hairy or only slightly so.	21. *V. scabriuscula.*
Petals blue.	22. *V. conspersa.*

Note. — No attempt is made to include the hybrids in the key. In the following list the numbers given without collector's name refer to my own collection. In the case of common species, when only one record is given, it is the earliest complete record I have found.

1. VIOLA PEDATA L. Sp. Pl. 933. 1753

Occasional in the Todt Hill region and in the sandy regions on the west side of the island, rarely elsewhere. Some of the earlier records are: Todt Hill, May 12, 1877, *M. Ruger;* Court House, May 10, 1879, and Kreischerville, June 5, 1879, *N. L. Britton;* Mariner Harbor, May, 1881, *C. O. Thompson.* Specimens with white flowers, Todt Hill, May, 1882, *N. L. Britton,* and Garretsons, May 10, 1890, *G. D. Hulst;* with double flowers, Watchogue, May 11, 1884, *Arthur Hollick;* in blossom Nov. 4, 1883, Tottenville, *Arthur Hollick.* Our plants have the characters of var. *lineariloba* DC.

2. V. BRITTONIANA Pollard, Bot. Gaz. **26**: 332. 1898

V. septemloba of authors, not LeConte.

V. atlantica Britton, not Pomel.

New Dorp, May 8, 1876, *N. L. Britton.* Common on the lowlands. It was admitted on the authority of Geo. W. Wright as *V. delphinifolia* Nutt.* in the Flora of Richmond County.†

* Proc. Nat. Sci. Assoc. S. I. 8: 39. 10 My 1902.

† By Arthur Hollick and N. L. Britton. Staten Island, 1879.

3. V. PECTINATA Bicknell, Torreya **4**: 129. 30 S 1904; Bull. Torrey Club **32**: 255. *pl. 18.* 27 My 1905

Midland Beach, Sept. 2, 1909 (*6012*). The leaves of these plants need not be confused with the merely toothed leaves that may be developed in the latter part of the season on *V. Brittoniana* hybrids, for the teeth or incisions are regular and distinctive and not irregular or ragged as in the hybrids.

This is a new locality for this species, only four localities having been previously reported.

4. V. CUCULLATA Ait. Hort. Kew. **3**: 228. 1789

Common. A form with bright lavender flowers has been found in a wet grassy dell in the Bloodroot Valley woods, collected June 4, 1905 (*3792*), etc.; also along Moravian Brook, near Red Lane, May 25, 1895, *Wm. T. Davis.*

5. V. EMARGINATA (Nutt.) Le Conte

V. sagittata emarginata Nutt. Gen. **1**: 147. 1818.
V. emarginata Le Conte, Ann. Lyc. N. Y. **2**: 142. 1828.

Found in a piece of woodland bordering South New York No. 3 (Darcey's woods), Aug. 14, 1907 (*5084*), Sept. 19, 1908 (*5575*), Aug. 14, 1909 (*5978*); in the meadow on the east side of Bradley Avenue, May 23, 1909 (*5648*), June 19 (*5716*), Aug. 7 (*5905*), and Aug. 14 (*5963*).

The *V. emarginata* reported in Proc. Nat. Sci. Assoc. S. I. **8**: 39. 10 My 1902, is based on *V. fimbriatula* hybrids, collected by Arthur Hollick, Sept. 23, 1883, on Todt Hill, and May 12, 1890, in the Clove Valley.

This is an extension of the range of the species.

6. V. SAGITTATA Ait. Hort. Kew. **3**: 287. 1789

Common, but not so well represented in earlier collections. The earliest record I find is Brighton Avenue woods, May 26, 1883, *C. O. Thompson.*

7. V. FIMBRIATULA J. E. Sm. Rees Cyclop. no. 38. 1817

V. ovata Nutt. Gen. **1**: 148. 1818.
V. sagittata ovata T. & G. Fl. N. A. **1**: 133. 1838.

This is common, but often mixed with *V. sagittata.* Plants

with white flowers have been found near Little Clove Road, May 13, 1904 (*2838*), and Bloodroot Valley, May 6, 1905 (*3691*).

Dr. Arthur Hollick has found the form with white flowers abundant at the Fox Hills golf links.

8. V. PALMATA L. Sp. Pl. 933. 1753

Frequent in woodland regions. The earliest specimen I find collected is sheet *506* in the herbarium of the S. I. Assoc. of Arts and Sciences, collected on Ocean Terrace, May, 1878, *Arthur Hollick*. This species is very variable in form of leaves and hybridizes freely, thus furnishing many puzzling forms, some of which are practically not identifiable.

9. V. TRILOBA Schwein. Am. Journ. Sci. **5**: 57. 1822

V. palmata dilatata Pollard, in Britton, Man. 635. 1905. Not Ell.

Tottenville, May 31, 1884, and Ocean Terrace, May 23, 1885, *Arthur Hollick*; Ocean Terrace, Sept. 20, 1903 (*2535*).

I have followed Dr. E. Brainerd in giving this specific rank, but am rather inclined to consider it a subspecies.

10. V. SORORIA Willd. Enum. 263. 1809

Frequent in woodland regions. Richmond Hill, July 30, 1898, *W. T. Davis*; Bradley Avenue meadow, Aug. 14, 1909 (*5969*); Egbertville, Aug. 23 (*6008*), etc.

11. V. HIRSUTULA Brainerd, Rhodora **9**: 98. 29 Je 1907

V. villosa Nutt. and recent authors, not Walter.

V. sororia LeConte, and Eaton, not Willd.

Only a few plants of this have been found, in the woods west of Egbertville, June 14, 1908 (*5322*), Oct. 3, 1908 (*5613*), May 31, 1909 (*5684*).

12. V. PAPILIONACEA Pursh, Fl. Am. Sept. **1**: 173. 1814

Abundant. A form with white flowers was found on Emerson Hill, May 18, 1907 (*4684*). This was transplanted and bore white flowers the next season. Forms with leaves purplish on the lower side are frequent in spring.

13. V. AFFINIS Le Conte, Ann. Lyc. N. Y. 2: 138. 1826

This is quite common, but has been apparently overlooked by collectors. The only specimens I find collected by others are: Silver Lake, Sept. 2, 1883, *Arthur Hollick*, one plant mounted on sheet *555*, together with *V. blanda* and *V. pallens*, in the herbarium of the S. I. Assoc. of Arts and Sciences; Watchogue, June 9, 1907, *Wm. T. Davis.* In my own collection I have eighteen numbers, collected at various places on the island, the first of which is from the vicinity of the handkerchief factory, West New Brighton, Apr. 18, 1903 (*2016*), and the last from New Springville, July 19, 1909 (*5865*).

It may be noted here that the plants growing in the open look quite different from woodland plants, but the latter, when transplanted into the open, acquire the appearance of plants growing naturally in the open.

14. V. LANCEOLATA L. Sp. Pl. 934. 1753

Common. South Shore, May 6, 1866, *W. H. Leggett* (*?*); New Dorp, May 8, 1876, *N. L. Britton.*

15. V. PRIMULIFOLIA L. Sp. Pl. 934. 1753

Common. South Shore, May 6, 1866, West Side, July 22 1869, and Huguenot, Aug. 8, 1870, *W. H. Leggett.*

16. V. PALLENS (Banks) Brainerd

V. rotundifolia β pallens Banks, Prodr. 1: 295. 1824.

V. pallens Brainerd, Rhodora 7: 247. 31 D 1905.

Frequent. Originally included under *V. blanda.* South Side, May 6, 1866, *W. H. Leggett* (*?*); Rossville, May 21, 1882, *N. L. Britton.*

17. V. INCOGNITA Brainerd, Rhodora 7: 248. 31 D 1905

Dr. E. Brainerd has pronounced a number of my specimens from Staten Island as belonging to this species, but the only specimens of which I can be reasonably sure are some collected at South New York No. 3, Aug. 14, 1909 (*5975*). The others are not like the *V. incognita* of the north woods.

18. V. BLANDA Willd. Hort. Berol. *pl. 24.* 1806

V. amoena LeConte, Ann. Lyc. N. Y. **2**: 144. 1828.

V. Leconteana G. Don, Gen. Syst. **1**: 324. 1831.

V. blanda palustriformis A. Gray, Bot. Gaz. **11**: 255. 1886.

Common about ponds and in wet places in woodlands. South Side, May 6, 1866, *W. H. Leggett* (*?*); Egbertville, May 8, 1876, *N. L. Britton;* Martling Pond, Sept. 17, 1904 (*3421*).

19. V. ROTUNDIFOLIA Michx. Fl. Bor.-Am. **2**: 150. 1803

"Near New Springville," July 22, 1899, *Wm. T. Davis;* same place (Bulls Head), Oct. 15, 1905 (*4292*), Apr. 29, 1906 (*4313*), June 10, 1906 (*4378*).

20. V. PUBESCENS Ait. Hort. Kew **3**: 290. 1789

Frequent. The *V. striata* in the Flora of Richmond County was reported on the authority of Geo. W. Wright, based on specimens of *V. pubescens* collected at Garretsons, May 27, 1876, and at West New Brighton, May 15, 1879, *N. L. Britton;* also at Silver Lake, April 28, 1878, *Arthur Hollick.*

21. V. SCABRIUSCULA (T. & G.) Schwein.

V. pubescens scabriuscula T. & G. Fl. N. Am. **1**: 142. 1838.

V. scabriuscula Schwein. T. & G. Fl. N. Am. **1**: 142. 1838.

Frequent. Barrett's Dye Works, May 26, 1879, *Arthur Hollick.*

22. V. CONSPERSA Reichenb. Pl. Crit. **1**: 44. 1823

(?) *V. labradorica* Schrank, Denkschr. Bot. Gesell. Regensb. **2**: 12. 1818.

V. Muhlenbergii Torr. Fl. U. S. **1**: 256. 1824.

V. canina Muhlenbergii Traut. Act. Hort. Petr. **5**: 28. 1877.

Reported as *V. canina sylvestris* Regel in Flora of Richmond County. Frequent in low ground in woodland regions. Clove Lake, May 14, 1876, *N. L. Britton.*

HYBRIDS, ARRANGED IN ALPHABETIC ORDER

23. **Viola affinis × Brittoniana** hyb. nov.

Glabrous, excepting a slight puberulence on the upper surface and margin of leaf. Blade of leaf deltoid, with a broad shallow

sinus, 2.5–7 cm. long and the later leaves as broad, on petioles two or three times as long; margin cut about midway to the midvein into falcate lobes, the basal lobes broad and incised, the median lobe terminating the blade with a blunt apex. Scapes of blue flowers about equaling the petioles; auricles of calyx ciliolate, short and appressed or long and spreading; cleistogamous capsules green or purplish, finely puberulent or glabrate, about 1 cm. long, on ascending or erect slender peduncles about half as long as the petioles; seeds buff. (PLATE 11.)

In their vernal stage these plants resemble *Viola Brittoniana*, but the leaves are less deeply cut. The long-auricled calyx of the cleistogamous flowers shows also the relationship to this species. On the other hand the purple-mottled and puberulent capsules are unmistakable evidence of the relationship to *V. affinis*.

South Avenue, near Lambert Lane, June 9, 1907 (*4768*, type), transplanted and grown in garden for two seasons; Palmer Tract, Port Richmond, May 8, 1906 (*4321*), transplanted and grown for three seasons; near pond on South Avenue, May 29, 1909, transplanted and specimens taken June 20 (*5736*) and Aug. 12 (*5951*); Bradley Avenue, Aug. 7, 1909 (*5903*), also transplanted.

24. V. AFFINIS × CUCULLATA Brainerd, Rhodora **8**: 49. 27 Mr 1906

South New York No. 3, Sept. 19, 1908 (*5574a*); Egbertville, May 9, 1908, transplanted and specimens taken Sept. 26 (*5600*). Here probably belong also: Bradley Avenue, May 21, 1905 (*3728*), and Merrell Avenue and South Avenue, May 6, 1906 (*4318*).

25. **Viola affinis × fimbriatula** hyb. nov.

Young plants pubescent, older plants much less pubescent. Vernal leaf-blades oblong-ovate to broadly ovate, obtuse or acutish, subcordate or truncate, crenate, or irregularly toothed toward the base, densely ciliolate, 2.5–4 cm. long, 1.5–3 cm. wide, on slender petioles two to three times as long; aestival leaves deltoid to ovate, with the apex more acute, 3–9 cm. long, 2.5–6 cm. wide. Blue flowers overtopping the leaves, their calyx-lobes short and blunt, ciliolate, with short appressed ciliolate auricles; cleistogamous flowers sagittate, with longer and more spreading ciliolate auricles, on erect or ascending peduncles; capsules green or mottled with purple, puberulent or glabrous, 6–11 mm. long, in some plants entirely sterile; seeds buff to brown. (PLATE 12.)

Young plants resemble the corresponding cross with *V. papilionacea;* older plants show more the leaf character of *V. affinis.*

Emerson Hill, May 18, 1907 (*4683*, type), transplanted and specimens again taken Sept. 29 (*5239*); South New York No. 3 (Darcey's woods), May 11, 1907 (*4672*), transplanted and specimens again taken Sept. 29, 1907 (*5235*), and Aug. 6, 1909 (*5897*); Ocean Terrace, May 25, 1907 (*4713*), transplanted and specimens again taken Sept. 29 (*5243*); Egbertville, Oct. 3, 1908 (*5617*); New Springville, July 19, 1909 (*5866*).

26. **Viola affinis × hirsutula** nom. nov.

V. affinis × villosa Brainerd, Rhodora **8**: 56. 27 Mr 1906.

Rootstock fleshy, erect. Plant rather low, glabrous except the upper surface and margin of leaf, which has the characteristic pubescence of *V. hirsutula.* Blades of leaves broadly ovate to deltoid-ovate, acutish, but with a blunt tip, deeply cordate to nearly truncate at the base, 4–9 cm. long, 3.5–5 cm. wide, on slender petioles about twice their length, margin crenate-serrate with low teeth. Ripe but rather infertile capsule glabrous, about 7 mm. long.

Only one little plant of this was found on the island, in the woods west of Egbertville, Aug. 23, 1909 (*6005*). This was in the little patch of *V. hirsutula*, with plenty of *V. affinis* growing near.

The change in the name of the hybrid is due to the fact that *V. hirsutula* Brainerd takes the place of *V. villosa* of authors, not Walt.

27. **Viola affinis × palmata** hyb. nov.

Plant with scattered pubescence, intermediate in general appearance between the woodland form of *V. affinis* and *V. palmata.* Rootstock rather slender. Blades of leaves broadly triangular-ovate, 6–9 cm. long, 7–10 cm. wide in fully developed leaves, on slender petioles two to three times as long; apex obtusish, base with a broad sinus; margin ciliolate, irregularly toothed or shallowly lobed. Cleistogamous capsules purple-mottled, slightly puberulent, about 7 mm. long, on short ascending peduncles; calyx-lobes purplish, short, blunt, with short ciliolate auricles; seeds brown. (PLATE 13.)

One small colony was found in the woods west of Egbertville, Oct. 3, 1908 (*5615*), and one plant removed to my garden.

28. V. AFFINIS × PAPILIONACEA House, Rhodora 8: 119. 28 Jl 1906

Richmond, July 11, 1906 (*4487*); Palmer Tract, Port Richmond, May 18, 1907 (*4682*), transplanted and specimens collected Sept. 29, 1907 (*5238*), and Aug. 6, 1909 (*5900*); South New York No. 3, Aug. 14, 1909 (*5979, 5980*), and Oct. 2, 1909 (*6071*). Probably also: Egbertville, July 3, 1907 (*5006a*), and Aug. 23, 1909 (*6003a*); Bradley Avenue, Aug. 14, 1909 (*5968*).

29. V. AFFINIS × SAGITTATA Brainerd, Rhodora 8: 55. 27 Mr 1906

Palmer Tract, Port Richmond, May 18, 1907 (*4681*), transplanted and specimens collected Sept. 29 (*5237*); May 15, 1909, transplanted and specimens collected Aug. 6 (*5899*) and Aug. 12 (*5953, 5954*). A specimen collected in a meadow west of Richmond, Aug. 23, 1909 (*6001*), probably belongs here.

30. V. AFFINIS × SORORIA Brainerd, Rhodora 6: 221. 30 N 1904

Egbertville, May 31, 1909 (*5681a*), and Aug. 23 (*6004*); Bradley Avenue, Aug. 14, 1909 (*5968*).

31. V. BRITTONIANA × CUCULLATA House, Bull. Torrey Club 32: 255. *pl. 17*. 27 My 1905

V. notabilis Bicknell, Torreya 4: 131. 30 S 1904.

V. cucullata × *septemloba* Brainerd, Rhodora 8: 52. 27 Mr 1906.

Palmer Tract, Port Richmond, May 8, 1906 (*4321*); New Dorp, June 8, 1907 (*4750*), transplanted and specimens again taken Sept. 29, 1907 (*5248*); Bradley Avenue, May 23, 1909 (*5656*), transplanted and specimens again taken Aug. 12 (*5952*). Collected also at New Dorp ("Meadow near Egypt Island"), June 8, 1907, *Wm. T. Davis*, at the same time and place as my *4750*.

32. **Viola Brittoniana × fimbriatula** nom. nov.

V. Mulfordae Pollard, Proc. Biol. Soc. Wash. 15: 203. 1902.

V. fimbriatula × *septemloba* Brainerd, Rhodora 8: 51. 27 Mr 1906.

Vernal plants resembling *V. Brittoniana;* differing in having peduncles and petioles pubescent, calyx-lobes ciliolate, middle lobe of leaf longer. Aestival plants differing from *V. Brittoniana* in having larger leaves, with the middle lobe prominent, blades pubescent, on petioles about twice as long as blades. Cleistogamous capsules green, 12 mm. long, with some of the ovules abortive; seeds brown.

New Dorp, May, 1893, *N. L. Britton;* June 8, 1907 (*4751*); Bradley Avenue, May 23, 1909 (*5657*), transplanted and specimens again taken Aug. 12 (*5955*).

The change in name is due to the fact that *V. Brittoniana* takes the place of *V. septemloba* of authors, not LeConte.

33. **Viola Brittoniana × papilionacea** hyb. nov.

Slightly pubescent on the upper surface and margin of leaves, otherwise glabrous, 1.5–3 dm. tall. Rootstock fleshy, short, erect or ascending. Vernal leaves purplish beneath, ovate, obtuse, crenate or lobed; aestival leaves ovate to broadly triangular-ovate, irregularly toothed, or cut into falcate toothed or incised lobes, apex acute or obtuse, base cordate to truncate, blades 4–8 cm. long, 3–11 cm. wide, on petioles about three times as long. Petaliferous flowers large, the beard on lateral petals not strongly knobbed, peduncles equaling or shorter than the petioles; cleistogamous flowers sagittate, on short decumbent or ascending peduncles; capsules greenish, mottled with purple, about 1 cm. long; seeds as in *V. Brittoniana.* (PLATE 14.)

In its vernal stages it resembles the corresponding crosses with *V. affinis* and *V. cucullata,*' but later its cleistogenes serve to determine its relationship without doubt. A large vigorous clump was found in a meadow on the east side of Bradley Avenue, May 23, 1909 (*5658*), transplanted, and specimens collected July 24 (*5892*), Aug. 6 (*5901*), and Aug. 12 (*5950*, PLATE 14). A small plant was found at Great Kills, May 8, 1909, transplanted and specimens taken Aug. 12 (*5949*). The latter differs from the Bradley Avenue specimens in its smaller size, the later leaves less deeply cut, the calyx-lobes and auricles shorter, the capsules more purple, and the seeds dark, thus more approaching *V. papilionacea* in its later stage; while in its early stage it showed no marked differences from the other plants, except its smaller size.

34. V. BRITTONIANA × SAGITTATA House, Rhodora **8**: 120. 28 Jl 1906

V. sagittata × *septemloba* Brainerd, Rhodora **8**: 51. *pl. 66.* 27 Mr 1906.

Oakwood, Sept. 1897, *N. L. Britton;* New Dorp, near foot of New Dorp Lane, July 29, 1899, and June 8, 1907, *Wm. T. Davis;* New Dorp (with Wm. T. Davis), June 8, 1907 (*4749*); Midland Beach, Sept. 2, 1909 (*6010*); Palmer Tract, Port Richmond, May 17, 1909, transplanted and specimens taken Sept. 12 (*6040*).

35. V. CUCULLATA × FIMBRIATULA Brainerd, Rhodora **6**: 217. 30 N 1904

V. Porteriana Pollard, Bull. Torrey Club **24**: 404. 1897.

Tottenville, Sept. 18, 1898, and Aug. 6, 1899, *Wm. T. Davis;* Bradley Avenue, May 21, 1907 (*4705*), transplanted and specimens taken Sept. 29, 1907 (*5241*); Little Clove Road, June 15, 1907 (*4779a*); Bradley Avenue, Sept. 13, 1908 (*5568*).

36. V. CUCULLATA × PALMATA Brainerd, Rhodora **8**: 56. 27 Mr 1906

Bradley Avenue woods, May 17, 1908 (*5307*), and May 23, 1909 (*5654*); Todt Hill, June 12, 1909 (*5697*).

When we recognize *V. triloba* as a species, these should be classed as *Viola cucullata* × *triloba.*

37. V. CUCULLATA × PAPILIONACEA Brainerd, Rhodora **8**: 56. 27 Mr 1906

Ocean Terrace, May 25, 1907 (*4716*).

38. V. EMARGINATA × FIMBRIATULA Brainerd, Rhodora **8**: 57. 27 Mr 1906

South New York No. 3 (Darcey's woods), Aug. 14, 1907 (*5085*); Bradley Avenue, Aug. 14, 1909 (*5961, 5965*).

39. V. EMARGINATA × SAGITTATA Brainerd, Rhodora **8**: 58. 27 Mr 1906

Bradley Avenue; Aug. 14, 1909 (*5957–5959*).

40. **Viola fimbriatula × hirsutula** nom. nov.

V. fimbriatula × *villosa* House, Rhodora **8**: 121. 28 Jl 1906.

Plant pubescent, low, with erect or ascending rootstock. Leaf-blades thick and firm, dark green above, ovate, acute, cordate, crenate-serrate, ciliate and appressed-pubescent, with the characteristic hairs of *V. hirsutula* on the upper surface; petioles one to two times as long as the blades. The imperfectly developed cleistogenes sagittate, small, on short decumbent or ascending puberulent peduncles; calyx-lobes purplish, lanceolate, with rather long ciliolate auricles. (PLATE 15.)

Woods west of Egbertville, in the *V. hirsutula* patch, Aug. 23, 1909 (*6007*).

41. V. FIMBRIATULA × PALMATA Robinson, Rhodora **8**: 53. 27 Mr 1906

Ocean Terrace, May 25, 1907 (*4712*); Bradley Avenue woods, May 17, 1908 (*5309a*).

42. V. FIMBRIATULA × PAPILIONACEA Brainerd, Rhodora **8**: 54. 27 Mr 1906

Iron Mines, Jewett Avenue, Apr. 25, 1903 (*2021*); Ocean Terrace, Apr. 26, 1903 (*2038*), May 18, 1906 (*4516a*), May 25, 1907 (*4715*), the last transplanted and specimens taken Sept. 29, 1907 (*5245*); Little Clove Road, May 3, 1907, transplanted and specimens collected Oct. 13, 1907 (*5281*); Little Clove Road June 15, 1907 (*4776*).

43. V. FIMBRIATULA × SAGITTATA Brainerd, Rhodora **8**: 57. 27 Mr 1906

Rossville, Aug. 6, 1869, *W. H. Leggett* (?); Court House, May 10, 1879, *N. L. Britton*; Ocean Terrace, May 10, 1879, *Arthur Hollick*. Common with the putative parents. Where the two species grow together it is difficult to find the pure species unmixed; they cross freely, and the hybrids show marked fertility.

44. V. FIMBRIATULA × SORORIA Brainerd, Rhodora **6**: 218. 30 N 1904

New Dorp, June 3, 1897, *A. A. Tyler*; Grasmere, May 29, 1907 (*4720*), transplanted and specimens taken Sept. 29, 1907 (*5246*).

45. V. HIRSUTULA × PAPILIONACEA Brainerd, Rhodora **9**: 98. 29 Je 1907

V. papilionacea × *villosa* House, Rhodora **8**: 121. 28 Jl 1906.
? *V. villosa cordifolia* Nutt. Gen. 148. 1818.
? *V. cordifolia* Schwein. Am. Jour. Sci. I. **5**: 62. 1822.
? *V. villosa cordata* Torr. Fl. U. S. **1**: 252. 1824.

Egbertville, June 14, 1908 (*5322a*), Oct. 3, 1908 (*5611* and *5612*), transplanted and specimens taken Aug. 12, 1909 (*5956*).

46. **Viola hirsutula × sororia** hyb. nov.

Dark green, pubescent, 2 dm. tall. Leaf-blades broadly ovate, obtuse, cordate or somewhat reniform, upper surface appressed-pubescent with the characteristic hairs of *V. hirsutula*, lower surface pubescent on the veins; margin ciliate, crenate; petioles ascending, pubescent, one to three times as long as the blades. Cleistogenes not fully developed, small, on prostrate or decumbent peduncles; calyx purplish, with short ciliolate auricles. (PLATE 16.)

This resembles the corresponding cross with *V. papilionacea*, differing chiefly in having pubescent petioles and lower surfaces of leaves. A small colony was found in the *V. hirsutula* patch at Egbertville, May 31, 1909 (*5682*, type), and one plant transferred to my garden.

47. **Viola lanceolata × primulifolia** hyb. nov.

Plant taller and more slender than *V. primulifolia*, and in general appearance intermediate between this and *V. lanceolata*. Leaf-blades ovate to lanceolate, acute or obtuse, decurrent on the petiole, margin crenate with low teeth, the points of which are incurved. Early flowers on long slender peduncles equal to or longer than the petioles; capsules green, about 8 mm. long; seeds brown. (PLATE 17.)

Plants collected at Grasmere, May 29, 1907 (*4723*, type), and some transplanted at home, showed the same intermediate character at the end of the season, with a general appearance more like *V. lanceolata* at the end of the season. Other specimens were found on South Avenue, June 9, 1907 (*4760*), transplanted and specimens again taken Sept. 29, 1907 (*5249*); also at Watchogue, Sept. 20, 1908 (*5585*), and from transplanted material Aug. 6, 1909 (*5898*). To this hybrid belong probably also: Tottenville, Sept. 9, 1868, *W. H. Leggett* (?); Watchogue, Sept. 30,

1883, *Arthur Hollick* (sheets *561*, *562*, and *572* in the herbarium of the Staten Island Association of Arts and Sciences); Woodrow, June 22, 1907, *Wm. T. Davis.*

48. **Viola pallens × primulifolia** hyb. nov.

Freely stoloniferous, pubescent on the peduncles and petioles, about 2 dm. tall. Leaf-blades pale beneath, ovate, acute or obtuse, subcordate to cordate, crenate with low incurved teeth, 4–6 cm. long and 3 5–5 cm. wide in mature leaves, sometimes as wide as long, on petioles about three times as long. White flowers on long slender peduncles equaling or longer than the petioles; capsules green, 5–8 mm. long; seeds small and dark. (PLATE 18.)

The specimen shown in the plate was taken from my garden Sept. 22, 1908 (*5596*), after having been transplanted from South Avenue, July 25, 1907 (*5059*). This shows a marked resemblance to *V. primulifolia*, and would probably have been so labeled without closer study. It differs from this in its shorter, more ovate and cordate leaf-blades, and in its small dark seeds characteristic of *V. pallens.* Other specimens are: Bulls Head, Aug. 18, 1906 (*4576*); Merrell Avenue, near South Avenue, Sept. 16, 1906 (*4621*), and June 9, 1907 (*4759*); South New York No. 3 (Darcey's woods), May 11, 1907 (*4670*), Aug. 14, 1907 (*5086*), and Oct. 2, 1909 (*6067*); South Avenue near Arlington, June 9, 1907 (*4764*), and from transplanted material Sept. 29, 1907 (*5250*); woods between South Avenue and the fireworks factories at Bulls Head, Sept. 8, 1907 (*5196*); Bradley Avenue, Aug. 14, 1909 (*5972*). Here probably belong also: Watchogue, May 11, 1884, *Arthur Hollick* (sheet *553*); Graniteville, July 16, 1898, *Wm. T. Davis.*

49. **Viola palmata × papilionacea** Brainerd, in herb., hyb. nov.

This differs from *V. palmata* in the direction of *V. papilionacea* by the more entire leaves, its scant pubescence, smaller flowers on shorter peduncles, while it resembles *V. palmata* in having irregular shallow lobes on the leaves, the veins prominent, and being more or less pubescent.

Specimens can not be assigned here with absolute certainty on account of the similarity in the fruit of *V. palmata*, *V. papilionacea*, *V. sororia*, and *V. triloba*, but I believe the following belong here: Ocean Terrace, May 23, 1903 (*2127*); Little Clove Road,

toward Ocean Terrace, May 13, 1904 (*2839*), and June 15, 1907 (*4777*).

50. V. PALMATA × SAGITTATA Brainerd, Rhodora **8**: 54. 27 Mr 1906

Middletown Forest, June 4, 1905 (*3791*); Bradley Avenue woods, May 21, 1907 (*4706*), transplanted and specimens collected Sept. 29, 1907 (*5242*); Bloodroot Valley woods, Aug. 13, 1907 (*5083*); Egbertville, Oct. 26, 1907 (*5292*), and June 14, 1908 (*5321*).

51. V. PAPILIONACEA × SAGITTATA Brainerd, Rhodora **8**: 54. 27 Mr 1906

Palmer Tract, Port Richmond, May 18, 1907 (*4681*), transplanted and specimens taken June 20, 1909 (*5735*); Emerson Hill, May 18, 1907 (*4687*).

52. **Viola papilionacea × sororia** Brainerd, in herb., hyb. nov.

This differs from *V. sororia* in having longer petioles, thinner leaves, and less pubescence, while it differs from *V. papilionacea* in being decidedly more or less pubescent.

Here are placed the following: Grasmere, May 29, 1907 (*4721*); transplanted and specimens taken Sept. 29, 1907 (*5247*); Emerson Hill, May 18, 1907 (*4685, 4686*); Egbertville, May 31, 1909 (*5681*).

This list does not include all the violet hybrids growing on Staten Island, for I have in cultivation some suspected hybrids, the exact identity of which is not definitely established; but the above list of thirty hybrids is perhaps longer than would be expected. It is not surprising, however, to find so many hybrids, when we consider the fact that the trees are being cut down in the woodlands and the natural surroundings of the plants continually disturbed. It seems that under the changed conditions they hybridize more freely. In this connection it is interesting to note that while it is difficult to find typical *V. hirsutula*, several of its hybrids have been found growing in its immediate vicinity.

The large number of species found on so restricted an area is partly accounted for by the fact that the terminal moraine crosses

the island and that there are thus two life zones represented. Attention may here be called to *V. rotundifolia* as a remnant of mountain flora growing in the lowlands between Bulls Head and New Springville. In this connection may be mentioned also *Aster acuminatus* Michx., which grows in the same place, near Bulls Head, and at two other places in the low woods towards the west and south.

Since Staten Island is a part of Greater New York, and real estate improvements are continually encroaching on nature, some of the species are scarce, and the localities in which they are found may soon be used for city lots. Thus these species may be exterminated from the island, and their occurrence here will be chiefly of historical interest.

PORT RICHMOND, N. Y.

Explanation of plates 11-18

PLATE 11

Viola affinis × *Brittoniana* Dowell, × 2/3; *a*, plant collected June 9 (*no. 4768*); *b*, leaf and capsule from specimen collected June 20 (*no. 5736*); *c*, leaf from same plant Aug. 12 (*no. 5951*).

PLATE 12

Viola affinis × *fimbriatula* Dowell; *a*, plant collected May 18 (*no. 4683*); *b* and *c*, leaf and capsule from plant grown in garden, collected Sept. 29 (*no. 5239*); *a* and *b* × 5/6, *c* × 5/4.

PLATE 13

Viola affinis × *palmata* Dowell, × 3/5. (*No. 5615.*)

PLATE 14

Viola Brittoniana × *papilionacea* Dowell, × 1/2. (*No. 5950.*)

PLATE 15

Viola fimbriatula × *hirsutula* Dowell, × 2/3. (*No. 6007.*)

PLATE 16

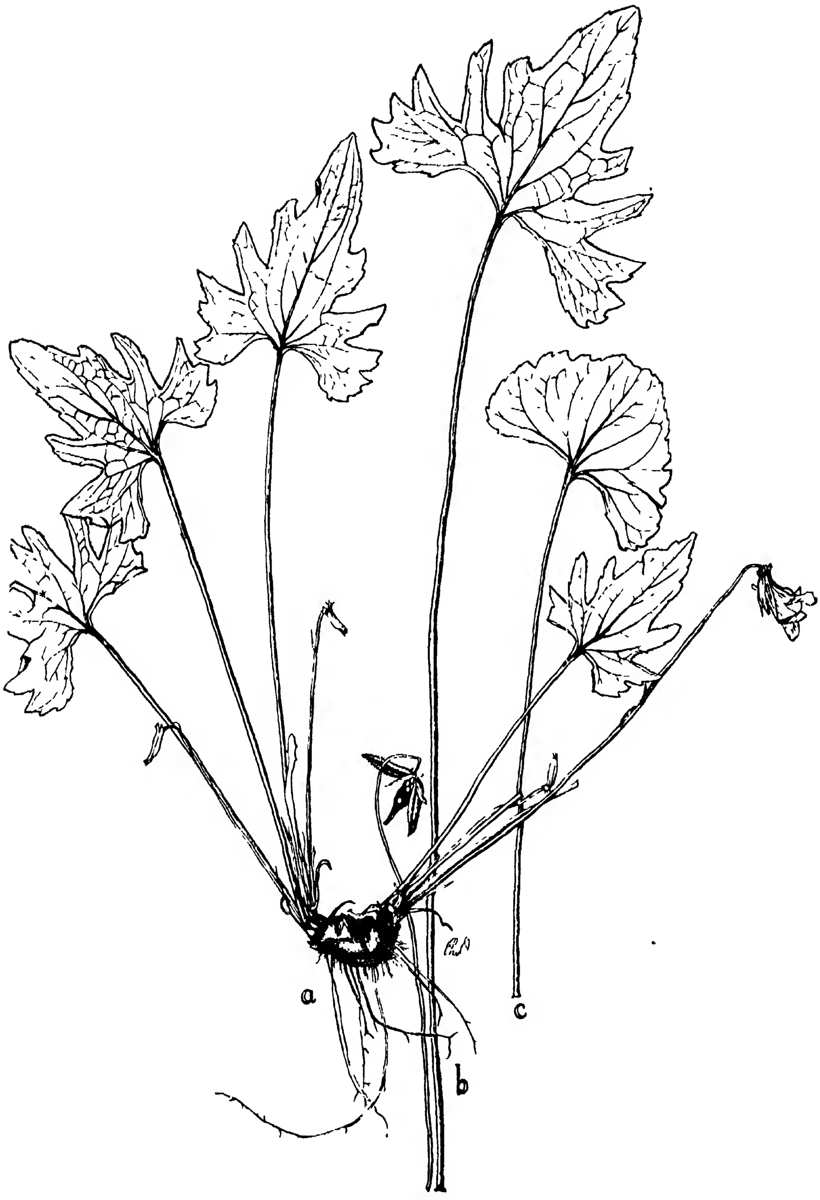
Viola hirsutula × *sororia* Dowell, × 2/3. (*No. 5682.*)

PLATE 17

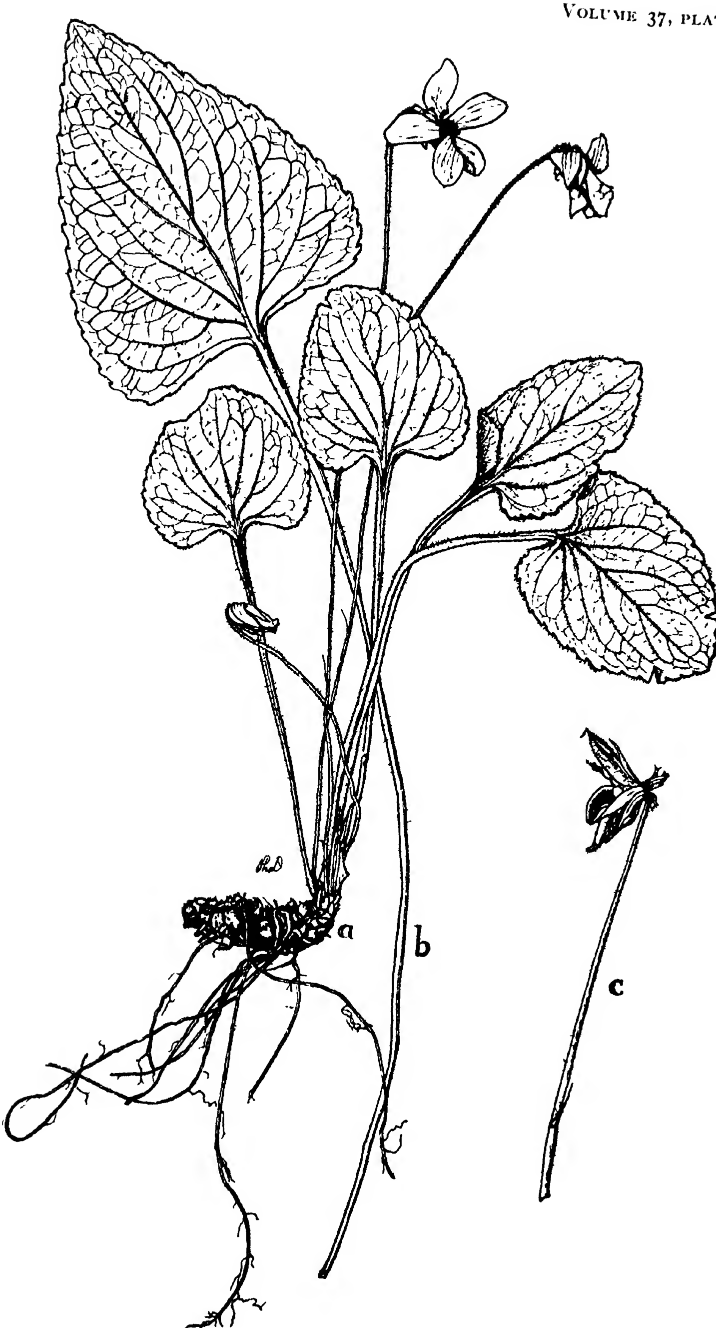
Viola lanceolata × *primulifolia* Dowell, natural size; *a*, plant collected May 29 (*no. 4723*); *b*, *c*, leaf and capsule from plant grown in garden, Sept. 29.

PLATE 18

Viola pallens × *primulifolia* Dowell, × 2/5. (*No. 5596.*)

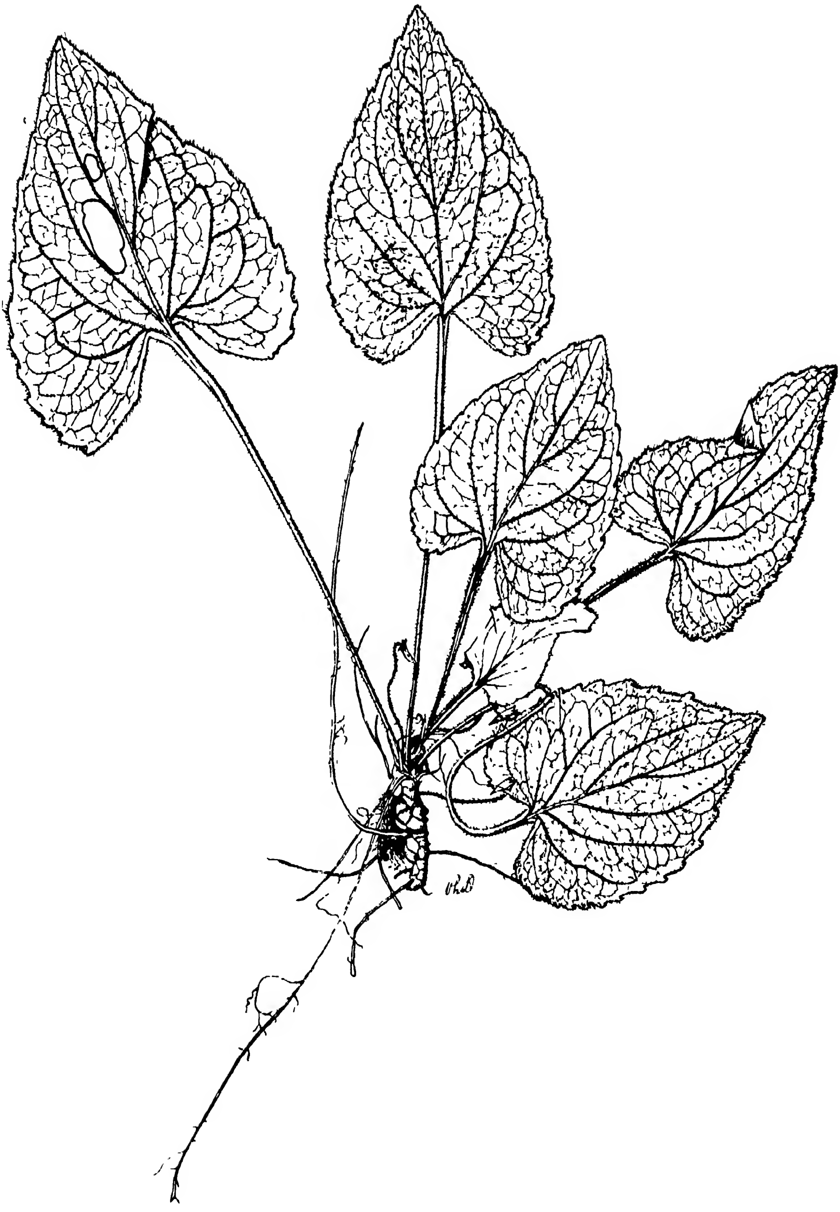


VIOLA AFFINIS × BRITTONIANA

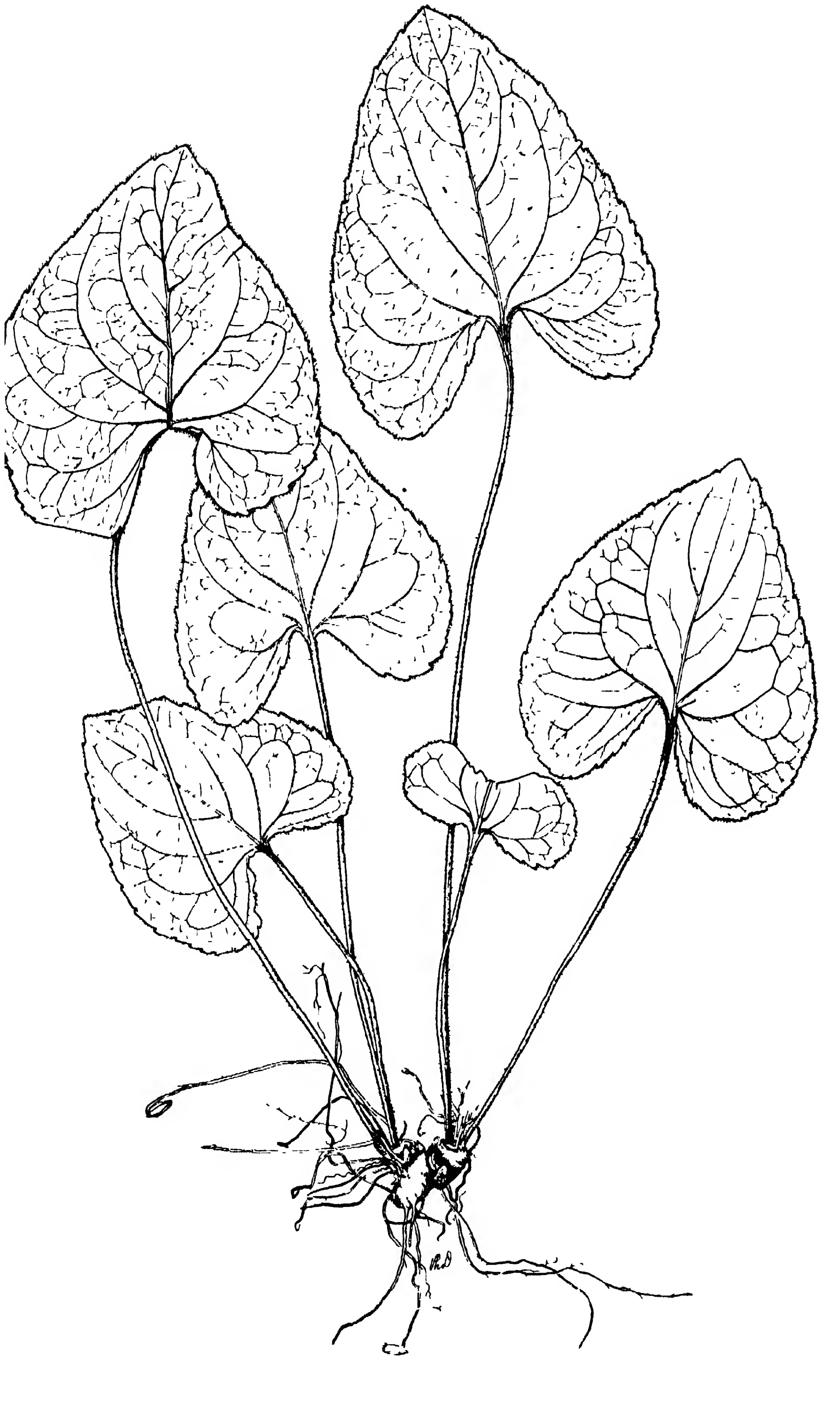

a
b
c


R.D

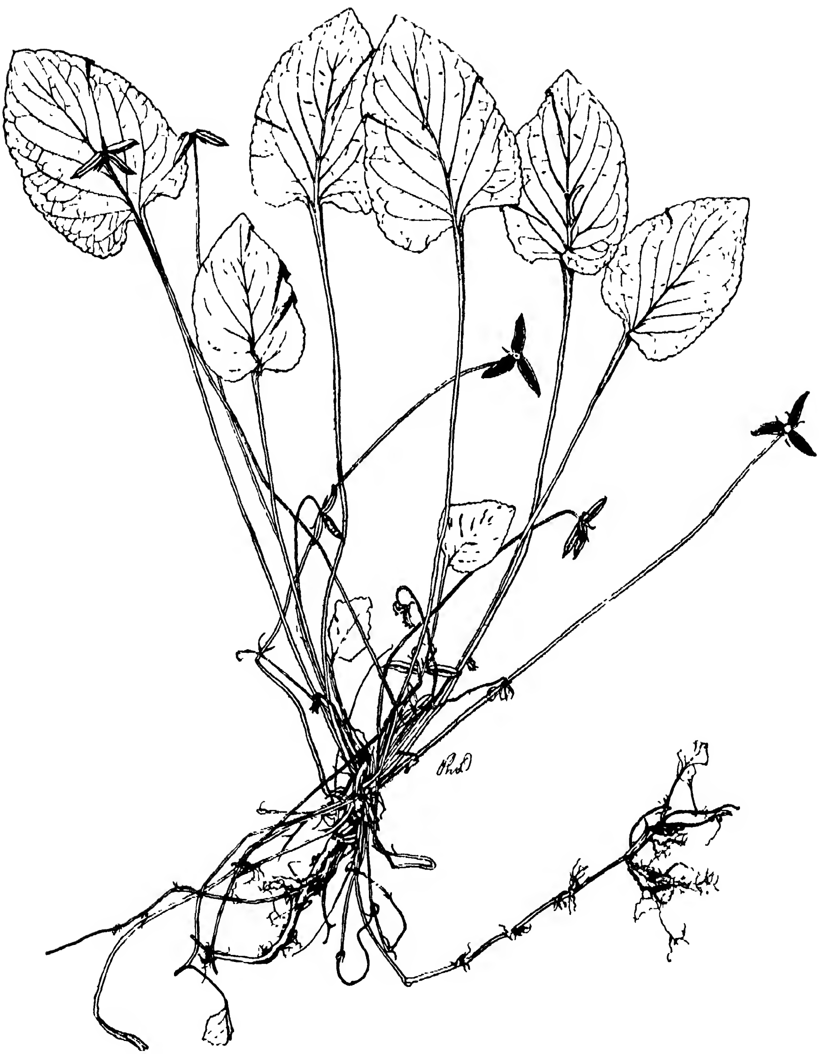
VIOLA BRITTONIANA × PAPILIONACEA



VIOLA FIMBRIATULA × HIRSUTULA



VIOLA LANCEOLATA × PRIMULIFOLIA



VIOLA PALLENS × PRIMULIFOLIA

Contributions to the Mesozoic flora of the Atlantic coastal plain — V.*
North Carolina

Edward W. Berry

(with plates 19–24)

In a brief communication by the writer published in 1907,† twenty-nine species of fossil plants were recorded from the Mid-Cretaceous deposits of North Carolina. Subsequently, *Tumion carolinianum* ‡ as well as two species of *Araucaria* § were deemed to be worthy of special description. The present paper adds twenty-nine species to this flora, bringing the total number of known forms up to sixty-one. These are all contained in the Black Creek formation and are of Mid-Cretaceous age, *i. e.*, somewhere in the lower half of the Upper Cretaceous. Continued exploration by Dr. L. W. Stephenson and the writer has increased the number of localities where Cretaceous plants have been found from four to twenty-five, all of which were unknown previous to 1907. The flora is not large and probably not more than a dozen or fifteen species will be added to it when the collections in hand are fully studied. It offers many interesting physical and biological problems which will be discussed in detail in a fully illustrated report upon this flora now in course of preparation for the North Carolina Geological Survey.

In the first contribution to this flora allusion was made to the striking absence of representatives of the class Gymnospermae, only one *Sequoia* having been recorded at that time and that one but sparingly represented. The present contribution increases the number of Gymnosperms to fifteen, which include two members of the order Cycadales and thirteen of the order Pinales. The family Taxaceae has one or more species and the remaining spe-

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† Berry, Bull. Torrey Club 34: 185–206. *pl. 11–16.* 1907.

‡ Berry, Amer. Jour. Sci. IV. 25: 382–386. *f. 1–3.* 1908.

§ Berry, Bull. Torrey Club 35: 249–260. *pl. 11–16 + f. 1, 2.* 1908.

cies are distributed as follows among the subfamilies of the Pinaceae: Araucarieae six species, Taxodieae four, Cupresseae one, and Abieteae one. Attention was called, also, to the absence of species of *Laurus* and *Salix* in the previous collections and the prediction was made that they would probably be found eventually. This prediction is now fulfilled, four species of *Salix* and two lauraceous forms being recorded on the following pages.

CYCADALES

PODOZAMITES KNOWLTONI Berry, Bull. Torrey Club **36**: 247. 1909

Podozamites angustifolius (Eichw.) Schimp. Pal. Végét. **2**: 160. 1870. Not Schenk, 1868.

This species was characterized by the writer in a recent issue of the BULLETIN. The North Carolina specimens are abundant but somewhat fragmentary at the Rockfish Creek locality and what is probably the same species, but too poorly preserved for certainty, occurs at the 92 mile-post on the Neuse River.

OCCURRENCE: Rockfish Creek near Hope Mills.

CYCADINOCARPUS CIRCULARIS Newb. Fl. Amboy Clays 46. *pl. 46. f. 1–4.* 1896

These supposed cycad-fruits are abundant in the Raritan formation of New Jersey and have been reported also from the Tuscaloosa formation of Alabama. They always occur as detached impressions but are well characterized and easily recognized.

OCCURRENCE: Big Bend, Black River.

PINALES

Araucaria Clarkii sp. nov.

Scale short and stout, broadly ovate, the body 12 mm. long and 9 mm. wide, not alate. Apex produced into a narrow recurved spine 3 mm. to 4 mm. in length. The enclosed seed, which is preserved in the type specimen, is obovate in outline, 4 mm. long and about 2.5 mm. wide.

This species is based upon a single specimen which is, however, clearly distinct from the large cone-scales of *Araucaria Jeffreyi* Berry, which are so common in the Black River Cretaceous out-

crops, and furnishes confirmatory evidence of the variety and abundance of the Araucarieae in our southern coastal plain during the first half of the Upper Cretaceous.

The present species is named for Prof. William B. Clark, geologist in charge of the coöperative investigations of the coastal plain in North Carolina.

OCCURRENCE: Court House Bluff, Cape Fear River.

BRACHYPHYLLUM MACROCARPUM Newb. (?) Fl. Amboy Clays 51 (footnote). *pl.* 7. *f.* 1–7. 1896

This species was collected by the writer on July 13, 1907, but the specimens were destroyed during shipment, for which reason the occurrence is queried, although there is no doubt as to its authenticity, especially as the writer has recently collected it a short distance south of the state boundary in South Carolina.

OCCURRENCE: Court House Bluff, Cape Fear River.

Androvettia carolinensis sp. nov.

Remains of leafy twigs consisting of much flattened, phylloclad-like, opposite twigs, the leaves on the flat surfaces being reduced to mere points and not visible without magnification, the marginal leaves strictly opposite and represented by a regular alternation of a blunt dentate lobe and a serrate point, the leaves being fused proximally. Venation consisting of immersed vascular bundles not seen except in a strong transmitted light. Midvein strong and straight; lateral veins, which are the midveins of the coalesced leaves, pinnately arranged and single in the pointed leaves; in the rounded leaves they are usually dichotomously forked but in this case the marginal lobes may represent two coalesced leaves; their angle of divergence greater than in *Androvettia statenensis* and the whole arrangement more distinctly cyclic in character. Texture very coriaceous, the epidermal cells, however, large, though with thick walls. Stomata fairly numerous, apparently on both surfaces, and consisting of sausage-shaped guard cells surrounded by four accessory cells. (PLATE 19, FIGURES 1–6.)

The general appearance of this species is even more fern-like than in the type of the genus, one reason being its smaller size and the absence in the collected material of the supposed male aments found in connection with some specimens of the Staten Island species. The present species is confined to the Tar River exposures of the Black Creek beds and is therefore considerably younger than the Staten Island form.

This remarkable genus was erected by Hollick and Jeffrey * for the reception of a single species discovered recently in the Upper Raritan deposits near Kreischerville, Staten Island, and the writers content themselves with a very good account of this species and refrain from framing a generic diagnosis. This laudable conservatism is abundantly justified by the writer's discovery of two additional species that cannot be generically separated from the Staten Island species and furnish a number of additional characters which serve to isolate this genus.

These remains are all entirely fern-like in superficial appearance, uniformly coriaceous in texture, and by the details of their external characters and internal structure are indubitable gymnosperms of the order Pinales. Their positive reference to the Araucarineae by Hollick and Jeffrey will, however, undoubtedly be questioned by many students. The North Carolina remains are not common and are confined to a single locality on the Tar River. The lateral leaves along the edges of phylloclad-like twigs are markedly opposite, while the scale leaves on its flat surfaces are much more reduced than in *Androvettia statenensis* and cannot be made out at all except in microscopical preparations of the epidermis, in which they are seen to be reduced to mere points of termination of certain leaf-traces. The lateral twigs are strictly opposite as is the course of the vascular bundles, which consist of a regular alternation of opposite simple bundles and dichotomously forked bundles. The remains from Georgia, previously mentioned, vary from *Androvettia statenensis* in the other direction and scarcely merit the term phylloclad-like; the leaves, both marginal and surficial, are opposite and well developed, very regular, with a vascular arrangement like that of the Carolina form. They are distichous and opposite on a naked stem, which is thus more fern-like in appearance than either of the other two species. Since the anatomy of these forms has not yet been studied, the reader is referred to the memoir cited above, where the histology of the Staten Island form is discussed.

Regarding the systematic position of this genus, as already remarked, its relationship with the Araucarian group of conifers is questionable. It seems clearly distinct from *Phyllocladus* and

* Mem. N. Y. Bot. Gard. 3: 22. 1909.

it is equally distinct from the various species of *Protophyllocladus* which have been recorded from the Raritan and later Cretaceous formations of North America. It seems equally distinct from *Thinnfeldia* but may possibly prove to be related to *Moriconia*. The comparisons of *Androvettia statenensis* with the Lower Cretaceous species *Ctenopteris insignis*, *Zamiopsis insignis*, *Thinnfeldia marylandicum* and *Plantaginopsis marylandica* are singularly unhappy. The writer will show in another place that the last two are monocotyledons and the others either ferns or cycads and not even remotely related to the forms under discussion.

OCCURRENCE: Three miles below Dunbars Bridge, Tar River, Edgecombe County.

DAMMARA BOREALIS Heer (?), Fl. Foss. Arct. 6^2: 54. *pl. 37. f. 5.* 1882

This species was collected at the same time as the *Brachyphyllum* referred to above and was likewise destroyed during shipment and is consequently queried, although there can be little doubt but that the specimens were of this species, which is so abundant at homotaxial horizons to the northward. It has also been discovered recently by the writer to the southward of North Carolina in the Tuscaloosa formation of Alabama.

OCCURRENCE: Court House Bluff, Cape Fear River.

SEQUOIA REICHENBACHI (Gein.) Heer, Fl. Foss. Arct. **1**: 83. *pl. 43. f. 1d, 2l, 5a.* 1868

Characteristic twigs of this widespread Mesozoic conifer occur at a number of localities in North Carolina. They are indistinguishable from the similar remains so common at a large number of localities in the Atlantic coastal plain.

OCCURRENCE: Rockfish Creek near Hope Mills; Parker Landing, Tar River; 92 mile-post, Neuse River.

SEQUOIA MINOR Velen. Sitz. K. Böhm. Gesell. **1886**: 638. *f. 11–13.* 1887

This species, which was described by Velenovsky from the Cenomanian of Bohemia and based on cone-bearing twigs, is new to the American flora unless possibly the specimen from the New

Jersey Raritan which Newberry identified as *Thuites Meriani* Heer is to be correlated with it.

OCCURRENCE: Big Bend, Black River; Parker Landing, Tar River.

CUNNINGHAMITES ELEGANS (Corda) Endl. Synop. Conif. 305. 1847.
— Newb. Fl. Amboy Clays 48. *pl. 5. f. 1–7.* 1896

This handsome species characterizes the Cenomanian and Senonian floras of Europe and the Magothy formation of eastern North America. Although Newberry is cited above, this species does not occur in the Raritan formation, his specimens having almost certainly come from the overlying Magothy formation.

As may be seen from the figures (PLATE 20, FIGURES 1–4), the North Carolina material is abundant and shows the characteristic leaf-scars of this species. The North Carolina forms are much more robust than any other specimens known to the writer, some of the leaves being 6.5 cm. in length and 4 mm. in width, so that it may be desirable eventually to consider them as representing a variety. However, as the usual size occurs sparingly in association with the larger examples it seems probable that both were borne by the same trees.

OCCURRENCE: Corbits Bridge, Horrell Landing, Sykes Landing, A. C. L. Bridge, Black River.

MORICONIA AMERICANA Berry, Bull. Torrey Club 37: 20. 1910

This Upper Cretaceous conifer is confined to the Bladen and homataxial horizons of the Atlantic coastal plain with a recorded range from New Jersey to South Carolina. The geometrical impressions of its symmetrical leafy twigs with their semicircular appressed leaves is so characteristic that the merest fragment is readily identifiable, even by a novice. (PLATE 20, FIGURE 5.)

OCCURRENCE: Elizabethtown, Cape Fear River.

Cephalotaxospermum gen. nov.

Fruits solitary (?), sessile or with an extremely short and stout peduncle, ovoid, somewhat pointed apically and inclined to become slightly cordate below, consisting of an outer fleshy layer and an inner bony layer, as in the Cycadales and Ginkgoales; its

surface mammillated much as in *Podocarpus elongata* but less markedly so. Bony endocarp ovate-acuminate, immersed in the apical part of the exocarp. Evidently the drupaceous fruits of some Cretaceous member of the Taxaceae which finds its closest homology in the recent flora in the fruits of *Cephalotaxus* and certain species of *Podocarpus*.

Cephalotaxospermum carolinianum sp. nov.

Fruit a drupe with the following dimensions as preserved in a much flattened condition: length 6 mm. to 13 mm., averaging about 10 mm.; breadth 5 mm. to 10 mm. averaging about 8 mm.; thickness about 3 mm.; fruit in life probably almost circular in cross-section. Peduncle short and stout or wanting. Stone ovate-acuminate, lying in the apical part of the fleshy exocarp with the beaked micropylar end reaching almost or quite to the apex. As preserved in a much flattened condition in the clays, these fruits tend to split into two parts, disclosing the bony endocarp or merely a cast of its cavity. The fleshy part of the fruit is carbonized and fails to show any histological details. There is some evidence or at least a suggestion in some specimens of the remains of a micropylar canal. Away from the pointed apex, the exocarp is 1 mm. to 2 mm. in thickness reaching a thickness of 3 mm. at the chalazal end.

These fruits are very abundant at certain localities in the Black Creek formation and they have been collected also in the extension of this formation near Florence, S. C., and in the upper part of the Tuscaloosa formation in Hale County, Alabama.

Fruits referable to the Taxaceae are extremely rare in the fossil state, as are also remains of foliage which can be referred with certainty to this family. Both *Tumion* and *Cephalotaxopsis* from the Lower Cretaceous of Maryland and Virginia are founded upon foliage which seems referable with considerable certainty to this family, and these same strata in those states abound in the foliage referred to the genus *Nageiopsis*, which seems to be closely related to *Podocarpus*, so that there is considerable reason for expecting to find Upper Cretaceous representatives of the family in this same general region. Heer * describes a leafy twig from the Patoot beds (Senonian) of Greenland with a large solitary fruit which he calls *Cephalotaxites insignis*, an identification which

* Heer, Fl. Foss. Arct. 7: 10. *pl. 53. f. 12.* 1883.

Solms-Laubach * seems to consider probable. Bertrand † has described carbonized seeds from the Aachenien of Tournay, Belgium, under the name of *Vesquia Tournaisii*, which he considers, because of the arrangement of the vascular bundles, as intermediate between *Tumion* and *Cephalotaxus*. It certainly seems to be not without significance that remains of this sort occur at nearly homotaxial horizons in America, Europe, and Greenland.

None of the foregoing, however, are comparable with the present forms, although certain indefinite remains described by Lesquereux as *Inolepis* sp.,‡ are remotely suggestive of them. It is not believed, however, that they are congeneric.

The modern genus *Cephalotaxus* Sieb. & Zucc., with four species, is confined to the China-Japan region, although it seems evident that it was much more widespread in former geologic times, and to it should probably be referred some of the leafy twigs included in the genus *Taxites* Brong. Fruits of three species of *Cephalotaxus*, apparently identified correctly, are described by Kinkelin § from the upper Pliocene deposits of the Main Valley in Germany. The considerations which seem to indicate a closer relationship with *Cephalotaxus* than with *Podocarpus* are the absence of the thickened peduncle of the latter and the presence of foliage in the same beds with these seeds described by the writer as *Tumion carolinianum* ‖ and which is of the same type as that of *Cephalotaxus* and might with propriety have been the foliage of the tree which bore the very abundant fruits here named *Cephalotaxospermum*.

OCCURRENCE: Seventy-four and three-fourths miles above Wilmington, Sykes Landing (common), Big Bend (very common), A. C. L. Bridge (very common), Corbits Bridge, all localities on the Black River in Sampson County; Parker Landing, Tar River (?).

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* Solms-Laubach, Fossil Botany 61. 1891.

† Bertrand, Bull. Soc. Bot. France 30: 293. 1883.

‡ Lesquereux, in Hayden's Ann. Rept. for 1874: 337. *pl. 4. f. 8.* 1876; Cret. and Tert. Fl. 33. *pl. 1. f. 8.* 1883.

§ Engelhardt & Kinkelin, Abh. Senckenb. Naturf. Gesell. 29[3]: 194. *pl. 23. f. 9–13.* 1908.

‖ Berry, Amer. Jour. Sci. IV. 25: 382–386. *f. 1–3.* 1908.

PINUS RARITANENSIS Berry (?) Bull. Torrey Club **36**: 247. 1909

Leaves in fascicles of threes, undoubtedly of this species, were collected by the writer on July 13, 1907, but were destroyed during shipment so that the occurrence is queried. It is associated with amber at Martha's Vineyard, Kreischerville, Staten Island, and Morgans, N. J., and with wood of *Pityoxylon* at the two latter outcrops, so that possibly the widely disseminated amber of the North Carolina Cretaceous may owe its origin to this same species.

OCCURRENCE: Court House Bluff, Cape Fear River.

ARALES

Pistia Nordenskioldi (Heer) Berry, comb. nov.

(PLATE 21, FIGURES 1–15)

Chondrophyllum Nordenskioldi Heer, Fl. Foss. Arct. 3^2: 114. *pl. 30. f. 4b; pl. 32. f. 11, 12.* 1874.—Berry, Bull. Torrey Club **34**: 198. *pl. 13. f. 1.* 1907.

This species of Heer's, described originally from the Atane beds of Greenland, was identified by the writer in 1907 among the scanty materials collected at Blackmans Bluff on the upper Neuse River in 1906 but its true botanical affinity was not determined. With the discovery of additional localities during the summers of 1907 and 1908 it was found to be exceedingly abundant and its true relations began to be suspected. In its size, outline, and venation it is scarcely to be distinguished from the modern *Pistia Stratiotes* L, which is certainly a variable and widely distributed, chiefly tropical, species. In this country it is found from Florida to Texas. Elsewhere it occurs in the West Indies and southward through Mexico and Central America to Paraguay and Argentina. In Africa it is found from Natal to Senegambia and Nubia, occurring also in Madagascar and the Mascarene Islands. In Asia it occurs throughout the East Indies and northward to the Philippines.

The fossil forms are more like the younger leaves of the modern plant (possibly a phylogenetic character in the latter), the later leaves tending toward a cuneate outline with a truncated apex and straighter sides.

A remarkable feature in connection with the North Carolina fossil form is that all of the figures on PLATE 21 except FIGURES 4 and 15 are made from sun prints of the actual leaves carefully washed out of the Cretaceous clays and subsequently mounted in balsam between glass. The epidermis is preserved in some instances and the stomata will be fully described in the final report. They are few and scattered and are confined to one surface and are altogether absent from the broad leaf-bases.

But few fossil forms have been referred to this genus. Hosius and von der Marck described in 1880 what they called *Pistites loriformis* from the Lower Senonian of Westphalia (Palaeont. **26**: 182. *pl. 38. f. 151, 152*) but this is probably cycadean, as Schenk suggested (in Zittel's Handbuch 378. 1890). Lesquereux in 1876 (Ann. Rept. U. S. Geol. and Geog. Surv. Terr. 299. 1874) named a remarkably well-preserved form from Point of Rocks, Wyoming, *Pistia corrugata*. This was fully described and illustrated in his Tertiary Flora (103. *pl. 61. f. 1, 3–7, 9–11.* 1883) and included leaves of various sizes and rootlets. It comes from beds belonging to the Montana formation (Senonian), which are of about the same age as the French beds from which the only other species is known. This latter, *Pistia Mazelii* was mentioned and figured from the lignites of Fuveau (Provence), France, by Saporta and Marion in their popular work, L'évolution du règne végétal, published in 1885 (Phanérogames **2**: 37. *f. 114C, D*) and has never been adequately described.

It is significant as showing how imperfect the geological record really is, even of the European tertiaries, that this widespread modern type ranged over at least two continents during the Upper Cretaceous and presumably had a still wider range in Cenozoic times, and yet not a single specimen has ever come to light at any of the thousands of localities where plant beds of the latter age have been exploited.

OCCURRENCE: Parker Landing, Tar River; Blackmans Bluff, Neuse River; A.C.L. Bridge, Big Bend, Sykes Landing, 56⅞ miles above Wilmington, Corbits Bridge, and Horrell Landing, on the Black River.

GRAMINALES (?)

Phragmites Prattii Berry, nom. nov.

Phragmites sp. Berry, Bull. Torrey Club **34**: 190. *pl. 11. f. 5.* 1907.

The present case is an admirable instance of the undesirable practice of not giving a specific name to specimens of somewhat indefinite botanical affinity which it becomes necessary to cite frequently in subsequent work and which cannot be done intelligently when there are dozens of "*Phragmites* sp." in the literature. To remedy this deficiency the above species is named in honor of the efficient state geologist of North Carolina.

OCCURRENCE: Court House Bluff, Prospect Hall, mouth of Harrisons Creek, Cape Fear River.

MYRICALES

MYRICA CLIFFWOODENSIS Berry, Bull. Torrey Club 31: 73. *pl. 4. f. 1.* 1904

Fruit which cannot be distinguished from that of this species, described from the Magothy formation at Cliffwood Bluff, N. J., is contained in the North Carolina collections.

OCCURRENCE: Parker Landing, Tar River.

POLYGONALES

Pisonia cretacea sp. nov.

Leaves ovate, 1.8 cm. in length by 1.3 cm. in greateat width, which is midway between the apex and the base. Apex wide and full, bluntly pointed. Base somewhat more narrowed and slightly decurrent. Petiole short and stout, about 3 or 4 mm. in length. Midrib narrowing rapidly from the base, slightly curved. Secondaries immersed. Margins entire.

This species differs from the only other Cretaceous species known, *Pisonia atavia* Velen. of Bohemia, in its relatively narrower outline, less rounded apex and longer petiole, both forms being of about the same size.

The present is the first undoubted Cretaceous species of this genus found in this country, and only one Tertiary species is known. The latter was recently collected by the writer from the upper Eocene of Georgia.

The existing species of *Pisonia* are numerous, inhabiting the tropics of both hemispheres, being largely developed in Central America and tropical South America, with several species in the West Indies and Antilles. Heimerl, in his treatment of the genus in Engler and Prantl's Natürlichen Pflanzenfamilien, divides it into six sections, some of which should undoubtedly be given generic rank, in fact Britton proposes to segregate the West Indian and Antillean species to form the genus *Torrubia* Vell., restricting *Pisonia* to the vines such as the type species, *Pisonia aculeata* L. However, in view of the foreign usage and what is more important, the geological considerations, which all point against following too closely systematists dealing only with the existing flora, especially when it is merely a question of the selection of a generic name among closely related modern forms, it is believed that a conservative course is most desirable in dealing with the fossil forms and the present new species is therefore referred to *Pisonia.*

Members of this genus are not rare as fossils, the oldest recorded species being based upon leaves from the Chlomeker sandstone near Leipa, Bohemia, and described by Velenovsky * as *Pisonia atavia.* These are of Upper Cretaceous, probably Cenomanian age, and if collected at a homotaxial horizon in this country would be referred to the genus *Persoonia* Swartz.† No other Cretaceous leaves have been referred to *Pisonia,* although Lesquereux‡ referred the only American species heretofore described, *Pisonia racemosa,* to the Laramie. Five species are recorded from the European Tertiary from beds ranging in age from the Ligurian to the Sarmatian. The present species is extremely close to *Pisonia eocenica* Ettings. from the lignites of Haering in the Tyrol, where it is represented by both leaves and fruit.

OCCURRENCE: Three miles below Dunbars Bridge, Tar River, Edgecombe County.

JUGLANDALES

JUGLANS ARCTICA Heer, Fl. Foss. Arct. 6^2: *71. pl. 40. f. 2; pl. 41. f. 4c; pl. 42. f. 1–3; pl. 43. f. 3.* 1882

This is another widespread Upper Cretaceous species which

* Fl. Böhm. Kreideformation 4: 6. *pl. 8. p. 13, 14.* 1885.

† Cf. *Persoonia Lesquereuxii* Knowlton, Mon. U. S. Geol. Surv. 17: 89. *pl. 20. f. 10–12.* 1892.

‡ Lesquereux, Tert. Fl. 209. *pl. 35. f. 4.* 1878.

has been found in the Black Creek formation of North Carolina. The present occurrence is based on leaflets, while the type material from the Atane beds of Greenland included not only leaflets, but also characteristic nuts and supposed aments. The present is the most southerly known occurrence of this species.

OCCURRENCE: Court House Bluff, Cape Fear River.

SALICALES

SALIX FLEXUOSA Newb. Ann. N. Y. Lyceum 9: 21. 1868

This willow, which is very common in the Magothy formation in the northern and central coastal plain, occurs sparingly in the Black Creek formation. It is present also in South Carolina and Alabama.

OCCURRENCE: Prospect Hall, Elizabethtown, Cape Fear River; Big Bend, Black River.

SALIX NEWBERRYANA Hollick, in Newb. Fl. Amboy Clays 68. *pl. 14. f. 2–7.* 1896

This serrate-margined willow leaf is present from the bottom to the top of the Raritan formation of New Jersey, but has not heretofore been found outside of that state. It is sparingly represented in North Carolina.

OCCURRENCE: Court House Bluff, Cape Fear River.

Salix eutawensis sp. nov.

Leaves lanceolate, somewhat falcate in some specimens, variable in size, from 5 cm. to 12 cm. in length and from 0.5 cm. to 2.3 cm. in greatest width, which is in the basal half of the leaf. Base lanceolate. Apex gradually narrowed to the attenuate tip. Margin entire for a short distance below, above which it is very finely dentate, even in the largest leaves collected. Petiole short and moderately stout. Midrib moderately stout, becoming thin in the apical part of the leaf, inclined to be curved or somewhat flexuous. Secondaries very fine and numerous, branching from the midrib at an acute angle and curving upward, becoming in their terminal portions approximately parallel with the margin, sending short curved tertiaries to the marginal teeth and from secondary to secondary. (PLATE 22, FIGURES 1–11.)

This species is abundant at the upper Tar River localities but has not been detected at any other localities in the Black Creek

beds of North Carolina. It is common in the Eutaw formation at Broken Arrow Bend on the Chattahoochee River in Georgia, from which place the type material was collected, and the present name was given in manuscript in allusion to the horizon. The Georgia material is more fragmentary than that from North Carolina, but withstands drying out much better, the latter being preserved in a loose carbonaceous sandy clay which furnishes miserable museum specimens. The drawings of this species were made, however, before the material had dried and weathered.

This typical willow leaf is quite modern in appearance, suggesting the existing *Salix nigra* Marsh., *Salix fluviatilis* Nutt., or the Mexican *Salix Bonplandiana* H.B.K., and is entirely distinct from any Cretaceous willows hitherto described. It approaches *Salix Newberryana* Hollick somewhat in general appearance, but is much more elongate-lanceolate in outline and ranges to a much smaller size, besides showing other distinctive features. It resembles also certain European Tertiary willows, as for example *Salix denticulata*, *S. Lavateri*, and *S. varians*. The fruits figured on the plate with the leaves of this species are found associated with these leaves and are believed to belong to the same species. These fruits are found at the second locality cited below.

OCCURRENCE: Three miles and three and one-half miles below Dunbars Bridge, Tar River, Edgecombe County, North Carolina.

SALIX LESQUEREUXII Berry, Bull. Torrey Club **36**: 252. 1909

Salix proteaefolia Lesq. Am. Jour. Sci. II. **46**: 94. 1868.

This species, which was described originally from the Dakota group, occurs in the Raritan formation but is especially abundant in the Magothy formation of the more northerly coastal plane. It is sparingly represented in the North Carolina collections but is abundant in the South Carolina Cretaceous and in the Tuscaloosa formation of Alabama.

OCCURRENCE: Big Bend, Black River.

URTICALES

Ficus Stephensoni sp. nov.

Leaves variable in size, ranging from 6 to 18 cm. in length and from 2.3 to 6.4 cm. in greatest width, broadly lanceolate-ovate,

tapering equally from the middle toward both ends but more fully rounded at the base and more slender toward the tip, especially in the smaller leaves. Midrib broad. Secondaries very slender, leaving the midrib at a wide angle, which becomes as great as 90° in some of the larger specimens, very numerous, 2–4 mm. apart, parallel, almost straight to the marginal vein, which is well marked and about 1 mm. distant from the margin, with which it is parallel. Veinlets largely at right angles to the secondaries and not especially well shown. Petiole stout. (PLATE 23, FIGURES, 2, 3.)

This is an exceedingly well-marked species of *Ficus* and is very close to various modern species in form and venation characters, as is well shown by the figure of a leaf of *Ficus elastica* Roxb. which is introduced for comparison on PLATE 23. It is probable, however, that the texture of the fossil species was less coriaceous, since all of the larger leaves are considerably macerated.

It is believed that the larger forms represent the normal size of the leaves in this species and that the smaller leaves, which occur only in material from South Carolina, represent abortive leaves which fell before reaching maturity, as is so commonly the case with the modern allied species.

The species is named in recognition of the diligent and careful collecting of Dr. L. W. Stephenson, who discoverd it at both Middendorf and Langley in South Carolina before the original material collected by the writer at Court House Bluff in North Carolina had been named.

Some authors refer leaves of this type to the genus *Eucalyptus*, with which genus the venation has much in common. In point of size the Carolina leaves are comparable with those of such a species as *Eucalyptus latifolia* Hollick, from Glen Cove, Long Island. The secondaries are less regular and only about half so numerous in the latter species and there seems to be little doubt of the propriety of referring the present species to the genus *Ficus*.

It is very similar to a variety of closely related Upper Cretaceous species of *Ficus* of the type of the existing *Ficus elastica* Roxb. and its allies, commonly cultivated as ornamental shrubs and trees under the name of "rubber plants." The comparable fossil forms include *Ficus glacoeana* Lesq. (see Fl. Dak. Group 76. *pl. 13. f. 1, 2.* 1892), with which there is a possibility that the present species may be identical, as it is very similar in outline and vena-

tion except that the figures of the Kansas leaves (types, 478 and 532a, Mus. Comp. Zoology) do not show any marginal vein, although Lesquereux mentions one in his description. The latter species has been detected southward along the western shore of the Mississippi embayment in the Woodbine formation of Texas and is of a more coriaceous texture, with more obtuse tip and with the secondaries going off at an angle of 60°. Another very similar species is *Ficus atavina* Heer (see Fl. Foss. Arct. 3^2: 108. *pl. 29. f. 2b; pl. 30. f. 1–8.* 1874) which ranges from the Atane and Patoot beds of western Greenland southward along the Atlantic coastal plain to Marthas Vineyard, Glen Cove, Long Island, and Cliffwood, N. J. (all probably of Magothy age).

The North Carolina leaf has full rounded basal margins (rather. straight in *F. atavina*) with less ascending secondaries, which are also twice as numerous as in *F. atavina;* the marginal vein is also closer to the margin. Another similar species, perhaps identical with the previous one, is *Ficus Peruni* Velen.* from the Cenomanian of Bohemia, which differs from the North Carolina leaf in the same respect in which *F. atavina* Heer differs. Velenovsky points out the great similarity between *F. Peruni* and *Eucalyptus Geinitzii* Heer, a similarity which is more striking in the forms which he has referred to this species of *Eucalyptus* than it is in the leaves usually so identified by other paleobotanists.

Several specimens of *Ficus* fruits were found at Court House Bluff and at Elizabethtown farther down the river, and these may possibly be from the same trees which furnished these large leaves.

OCCURRENCE: Court House Bluff, Cape Fear River.

ROSALES

Leguminosites robiniifolia sp. nov.

Sessile elliptical leaflets about 2.5 cm. in length by 1.5 cm. in greatest width, which is slightly below the middle. Apex and base obtusely rounded, the former slightly narrower than the latter. Midrib moderately stout. Secondaries obsolete.

Better material of this species, as yet undescribed, was collected in the Middendorf formation of South Carolina.

OCCURRENCE: Court House Bluff, Cape Fear River.

* Fl. Böhm. Kreidef. 3: 16 (41). *pl. 4* (*12*). *f. 1–3.* 1884. Compare his *fig. 2* with Berry, Bull. Torrey Club 31: *pl. 3 f. 6.* 1904.

Gleditsiophyllum gen. nov.

Compound leaves with more or less inequilateral, medium, or small leaflets, with camptodrome venation, identical with the leaflets of the modern species of *Gleditsia* * of eastern North America and Asia.

It has seemed wiser to establish a new genus for these forms whose name will indicate their resemblance to the modern genus *Gleditsia* without too great an indication of actual botanical identity since it is possible that these Cretaceous forms may represent some allied genus of the Caesalpinaceae with similar foliage. The modern *Gleditsia* has five or six upland species of eastern North America and Asia. The fossil species which have been described number eight and include remains of the living *Gleditsia triacanthos* from the Pleistocene of Kentucky and *Gleditsia donensis* from the interglacial deposits of the Don River Valley in Canada. The distribution of the Tertiary species includes two Oligocene records, five Miocene, and two Pliocene. Probably, also, certain forms referred to the comprehensive genus *Leguminosites* are related to the forms just mentioned.

Gleditsiophyllum triacanthoides sp. nov.

Leaflets ovate-lanceolate, medium in size, *i. e.*, intermediate between the large and the small leaflets of *Gleditsia triacanthos* L., about 3 cm. in length by 1 cm. in greatest width, which is about half way between the apex and the base. Apex and base bluntly pointed. Margin entire, as it often is in the modern species. Midrib of medium size. Secondaries numerous, parallel, delicate, branching from the midrib at an acute angle, less than 45°, camptodrome, exactly similar to the venation of the modern species cited.

The present is the first Cretaceous record of a *Gleditsia*-like form. It is perfectly distinct from any of the known Cretaceous leaves and resembles the European Tertiary forms of *Gleditsia* as well as certain Tertiary species of *Podogonium*. Leaflets with this outline and venation are liable to be confused with the leaves of the genus *Salix*, which may account for the absence of previous Cretaceous records.

OCCURRENCE: Three and one-half miles below Dunbars Bridge, Tar River, Edgecombe County, North Carolina.

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* Often spelled *Gleditschia*, from the botanist J. T. Gleditsch.

PHASEOLITES FORMUS Lesq. Fl. Dakota Group 147. *pl. 55. f. 5, 6, 12.* 1892

This common Dakota Group species is present in considerable abundance in the Tuscaloosa formation of Alabama, so that it is not surprising to find it in North Carolina, although the material from the latter state is rather incomplete.

OCCURRENCE: Court House Bluff, Cape Fear River.

SAPINDALES

CELASTROPHYLLUM UNDULATUM Newb. Fl. Amboy Clays 102. *pl. 38. f. 1–3.* 1896

This large species is represented in the Black Creek formation by even larger leaves than those found in the New Jersey Raritan. It is reported also by Smith from the Tuscaloosa formation of Alabama.

OCCURRENCE: Court House Bluff, Cape Fear River.

THYMELEALES

LAUROPHYLLUM ELEGANS Hollick, Mon. U. S. Geol. Surv. 50: 81. *pl. 27. f. 1–5.* 1907

Imperfect leaves of what appears to be this species, which was described in 1907 from the Cretaceous deposits of Long Island and Staten Island, occur in the Black Creek formation. It has also been recorded recently from the Magothy formation of Maryland.

OCCURRENCE: Court House Bluff, Cape Fear River.

Malapoenna horrellensis sp. nov.

Leaves ovate-lanceolate, about 8 cm. long by 2.5 cm. in greatest width, broadest at the evenly rounded or slightly acute base, narrowing gradually upward, the apex narrow and extended but obtusely pointed. Leaf substance thin but persistent, evidently coriaceous in life, since these leaves occur abundantly at a locality where all the vegetable remains except the resistant *Araucaria*, *Cunninghamites*, and *Pistia* were evidently thoroughly macerated before entombment. Secondaries 4–6 pairs, subopposite, curved upward, camptodrome, branching from the midrib at an acute angle, the lowest branching from the top of the petiole and extending upward half way to the apex or farther, giving the leaf

a triple-veined appearance (perhaps they should be termed lateral primaries, although they are much finer than the moderately stout midrib); next pair of secondaries branching at a less acute angle a considerable distance above the base, 1/3 to 1/2 the distance to the apex. Tertiary venation typically Lauraceous. (PLATE 24, FIGURES 1–9.)

The anomalous leaf of this species shown in FIG. 4 has a deeply retuse apex, giving it the appearance of a *Liriodendropsis*, which is belied by its association with the normal leaves and by the character of its venation and texture.

This species is markedly distinct from the species of Lauraceous leaves hitherto described in its rounded base, the only genus of this family with such a character being *Cinnamomum* and the present species being possibly liable to be confused with *C. Heeri* when only the basal part of the leaf is found. The general proportions and characters of the whole leaf, are, however, perfectly distinct.

The genus *Malapoenna* has more than one hundred existing species, chiefly of the oriental tropics, and is well represented in the fossil state from the Dakota and Magothy formations upward. It is especially well represented in the Paleocene of Europe and the Shoshone Group of America. There are two species in the Dakota Group of the west, one of which reappears in the Tuscaloosa formation at Cottondale, Ala., and the other in the Magothy formation of New Jersey.

OCCURRENCE: Horrell Landing, Corbits (Old Union) Bridge, Parker Landing, Tar River (?).

PRIMULALES

MYRSINE BOREALIS Heer, Fl. Foss. Arct. 3^2: 113. *pl. 32. f. 23.* 1874

This is a widespread and characteristic species of the lower part of the Upper Cretaceous, with a range extending northward to Greenland (Atane beds) and southward to Alabama (Tuscaloosa formation).

OCCURRENCE: Rockfish Creek near Hope Mills; Court House Bluff, Cape Fear River.

MYRSINE GAUDINI (Lesq.) Berry, Bull. Torrey Club 36: 262. 1909

A single leaf of this upper Raritan and Dakota Group species is present in the North Carolina collections.

OCCURRENCE: Court House Bluff, Cape Fear River.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MARYLAND.

Explanation of plates 19-24

PLATE 19.

FIGS. 1–6. *Androvettia carolinensis* Berry. Tar River.
Figs. 1, 3, 5, natural size. Figs. 2, 4, 6, × 4.

PLATE 20.

FIGS. 1–4. *Cunninghamites elegans* (Corda) Endl. Horrell Landing.
Fig. 2. Enlarged leaf-scar (× 3).
Fig. 3. Impression of same on clay (× 3).
FIG. 5. *Moriconia americana* Berry. Elizabethtown.

PLATE 21.

FIGS. 1–15. *Pistia Nordenskioldi* (Heer) Berry.
Figs. 1–3, 5–14. A. C. L. bridge, Black River.
Fig. 4. Parker Landing, Tar River.
Fig. 15. Near Blackmans Bluff, Neuse River.

PLATE 22

FIGS. 1–11. *Salix eutawensis* Berry. Tar River.

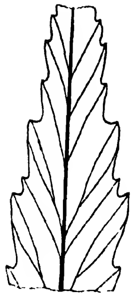
PLATE 23

FIG. 1. Young leaf of *Ficus elastica* Roxb., for comparison.
FIGS. 2, 3. *Ficus Stephensoni* Berry. Court House Bluff.

PLATE 24

FIGS. 1–9. *Malapoenna horrellensis* Berry. Horrell Landing.

1



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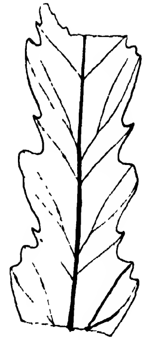
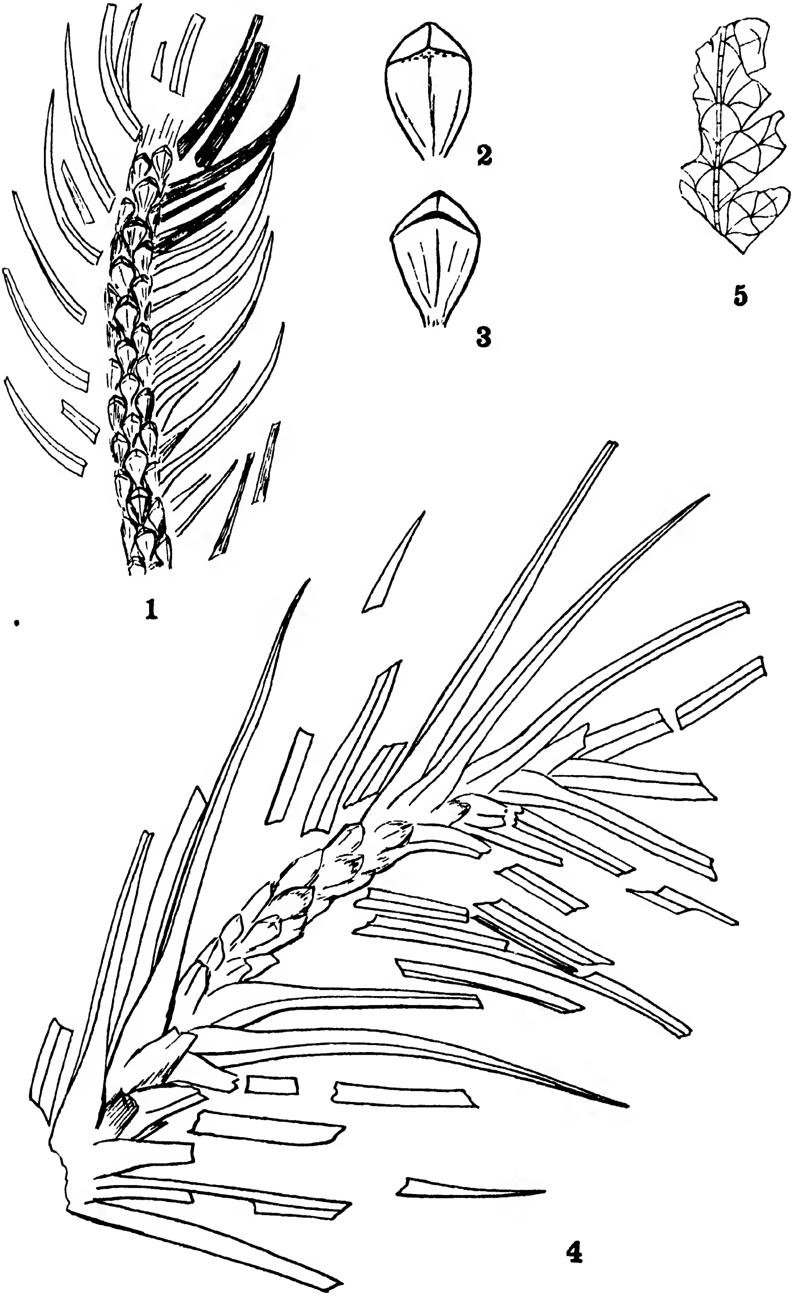


4

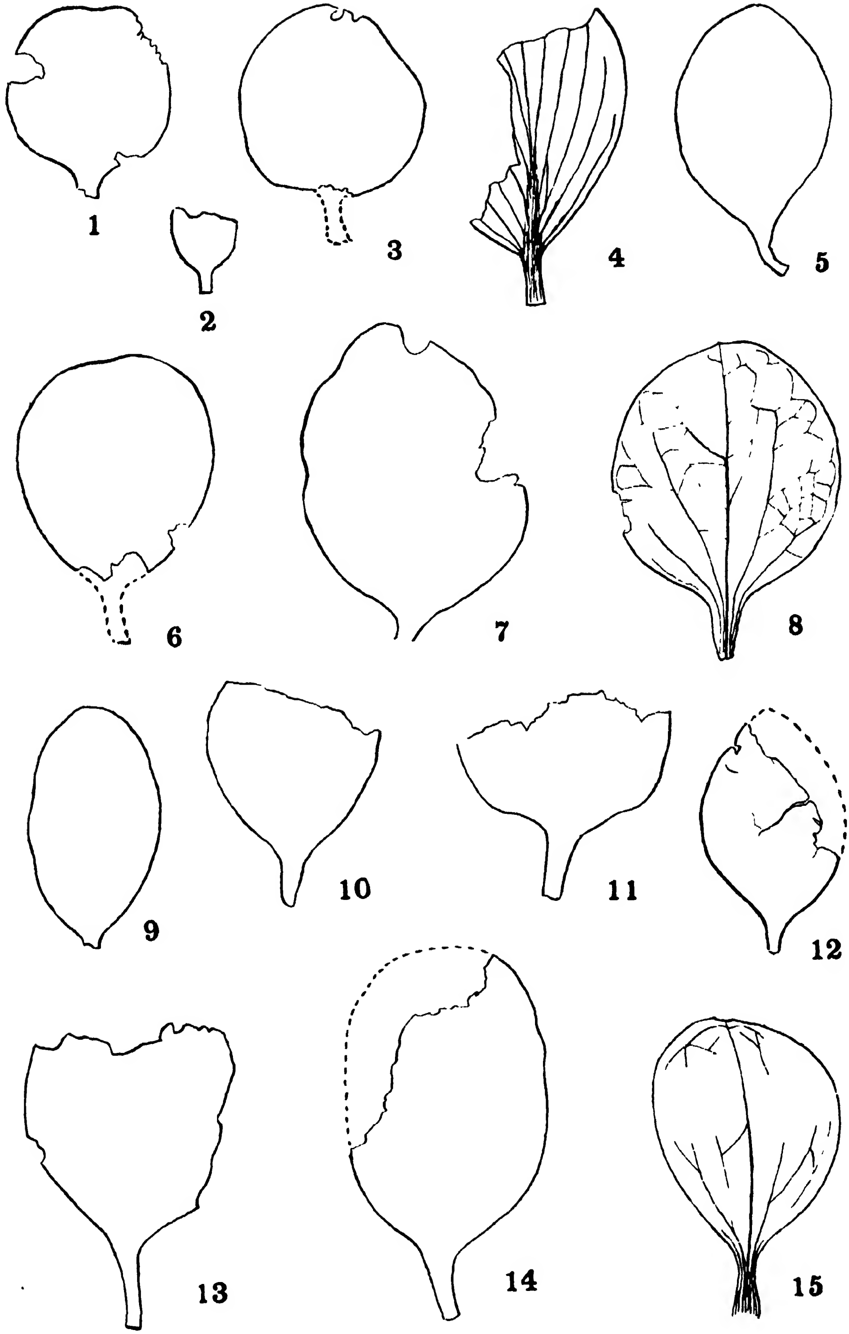
5

6

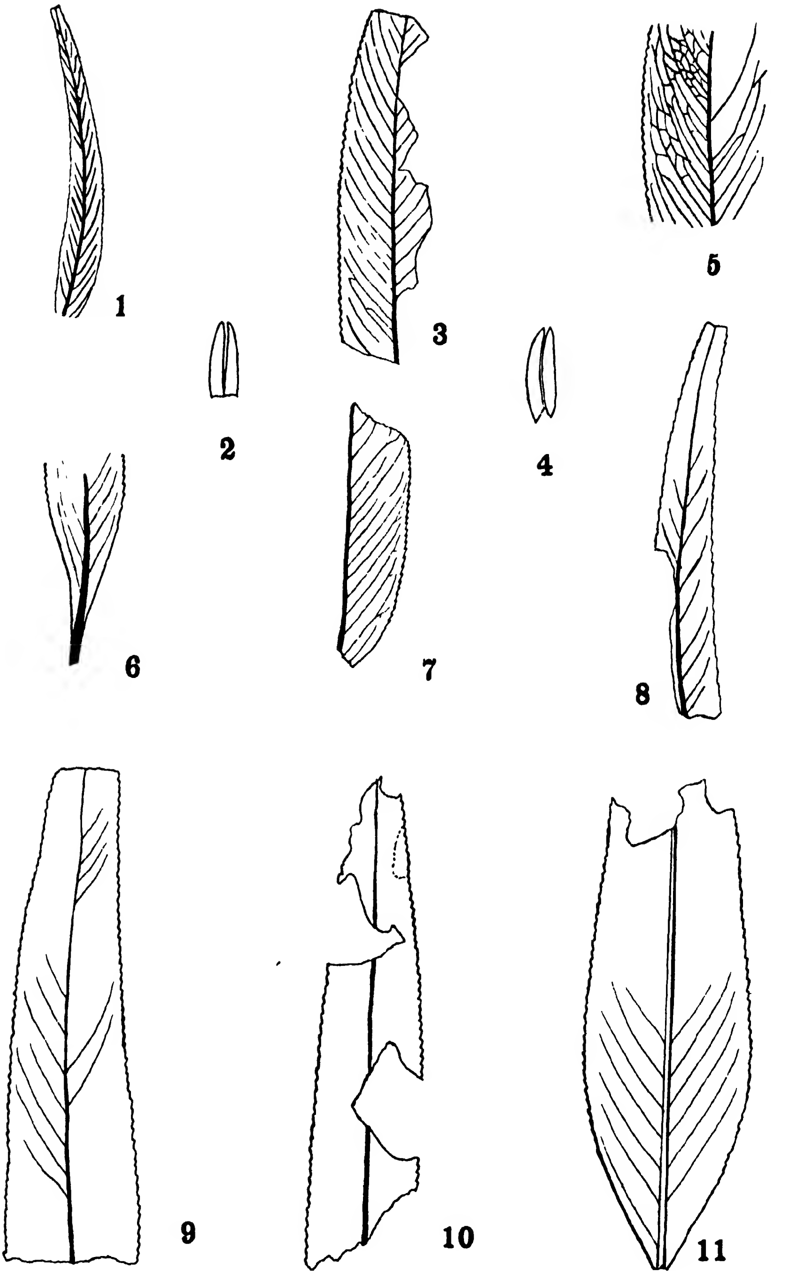
ANDROVETTIA CAROLINENSIS Berry



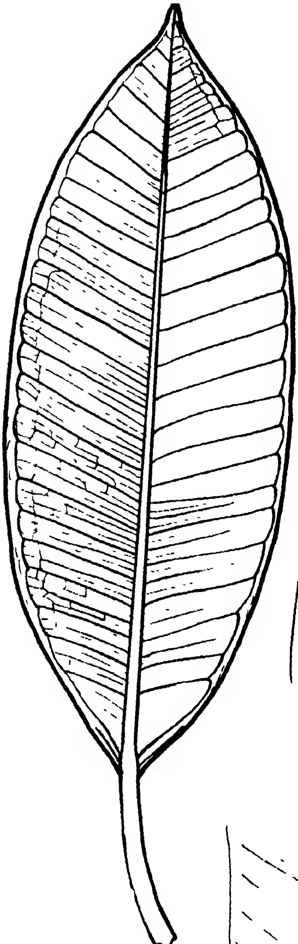
1–4. CUNNINGHAMITES ELEGANS (CORDA) ENDL.
5. MORICONIA AMERICANA BERRY



PISTIA NORDENSKIOLDI (HEER) BERRY



SALIX EUTAWENSIS Berry



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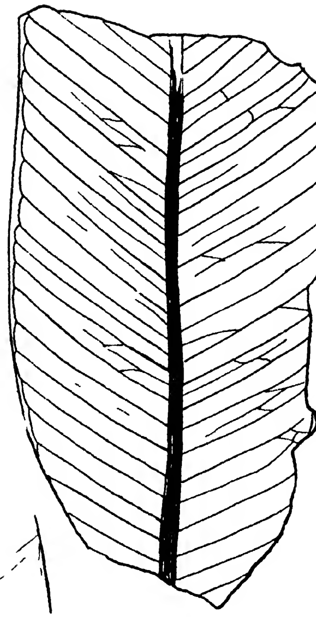

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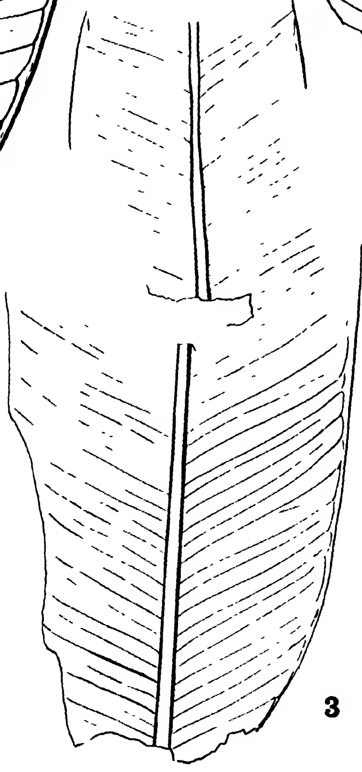
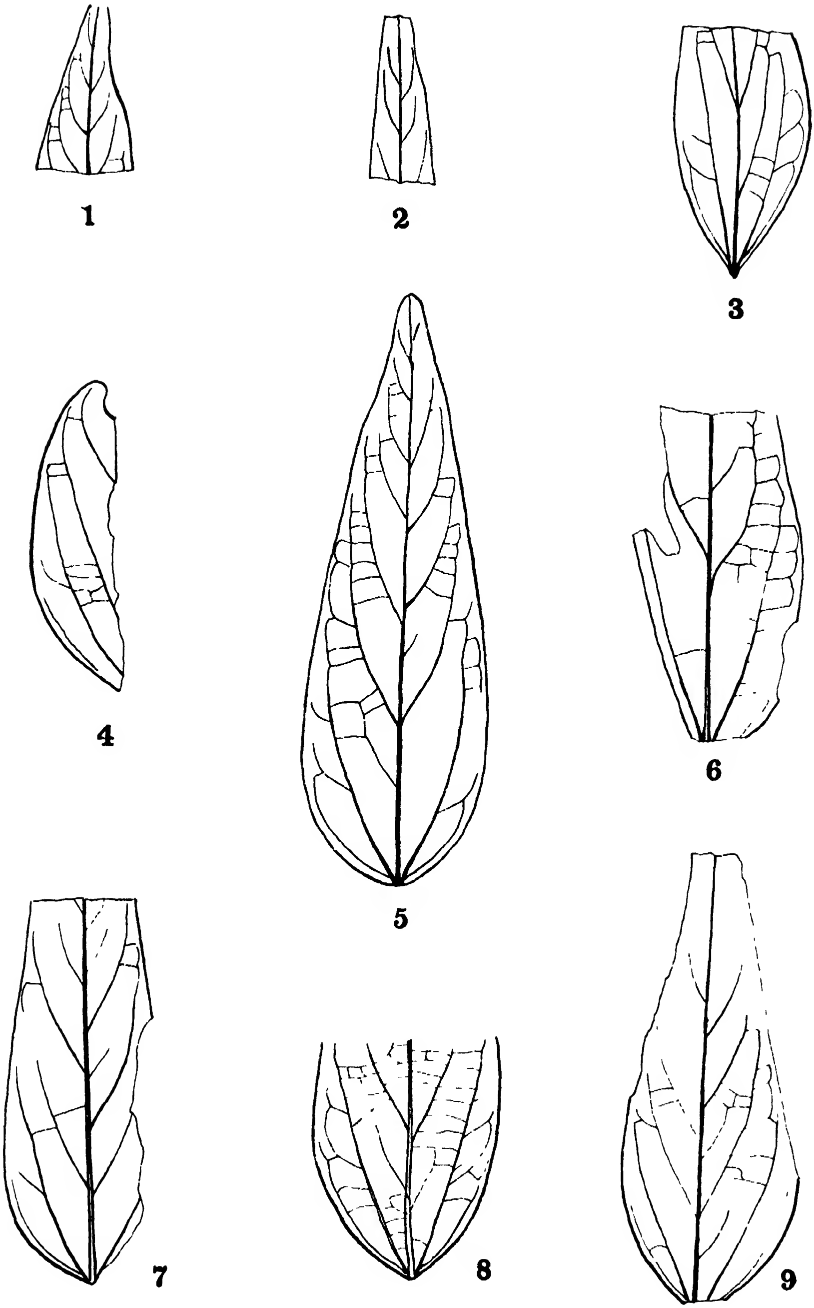


3

1. FICUS ELASTICA Roxb.
2, 3. FICUS STEPHENSONI Berry



MALAPOENNA HORRELLENSIS Berry

One of the hybrids in Dryopteris

Margaret Slosson

In a recent number of the Bulletin of the Torrey Botanical Club * Mr. Ralph C. Benedict cites fifteen crosses as occurring between the following six of our species of *Dryopteris*: *D. cristata*, *D. Clintoniana*, *D. Goldiana*, *D. marginalis*, *D. spinulosa*, and *D. intermedia*. Twelve of the fifteen hybrids have been described already.† Two are held for further study. The one remaining, *D. Clintoniana* × *marginalis*, is the subject of this paper.

This group of hybrid ferns is a difficult one, and plants are often found that are by no means easy to identify. This is partly due to our lack of knowledge of the range of variation normal to some of the parent species, or to be found in the different hybrids. *D. cristata* × *marginalis*, one of the best known and most common members of the group, appears to have a perfectly definite range of variation. It is impossible to say at present whether this is true of the others or not. Few have been collected in sufficient quantities to justify a conclusion. Most of them represent problems to be worked out.

The case is simplified by the fact that as a rule, at least, either the sporangia of these hybrids are abortive, or the spores, if present, are abnormal, and fertile hybrids, etc., are thus not likely to occur and confuse the outlook. Perhaps an exception to this may be found in *D. cristata* × *intermedia* (*D. Boottii*). Certainly the many plants of this hybrid, which occur so often, seem to indicate either a much more frequent hybridization than would be supposed probable, or some means of reproduction of the hybrid, perhaps asexual growth of some kind.

Dryopteris Clintoniana × *marginalis* I collected first at Pittsford, Vermont, in 1897, and again several times since then in

* 36: 41–49. 1909.

† See Bull. Torrey Club 35: 135–140. 1908; 36: 41–49. 1909. — Rhodora 6: 75–77. 1904. — Bot. Gaz. 19: 492–495. 1894.

the same locality. It grows there on the outskirts of a deeply wooded sphagnum swamp, near plants of both *D. Clintoniana* and *D. marginalis.* It may be described as follows:

Dryopteris Clintoniana × marginalis hyb. nov.

Rhizome stout, caudiciform or more or less decumbent; stipes about one third to seven eighths as long as the laminae; stipe-scales large and small mixed, light brown, often with dark centers, lanceolate to ovate, acuminate, subentire or ciliate-toothed; laminae 35–60 cm. long, 16–25 cm. broad, oblong-lanceolate or elliptic, acuminate; pinnae, excepting the uppermost, short-stipitate, varying from oblong-lanceolate to elliptic-lanceolate in the main part of the laminae to ovate-lanceolate at or near the base, mostly all long-acuminate, deeply pinnatifid or at base subpinnate, inequilateral, the inferior pinnulae the longest; pinnulae oblique, often subfalcate, oblong or ovate-oblong to lanceolate, obtuse or the longer often subacute to long-acute, the longest either at or near center or base of the pinna, few, usually the basal if any, constricted at base, obscurely notched or toothed or sparingly crenate-serrately toothed or lobed, the lobes often obscurely toothed; sori about 3–7 (rarely 8 or 9) pairs, nearer midveins than margins or midway between, a few occasionally submarginal; indusia glabrous.

Type in the Underwood Fern Herbarium, New York Botanical Garden, *M. Slosson,* from Pittsford, Vermont, 1908. Collected also by R. C. Benedict at Cornwall, Connecticut, July, 1907, and June, 1909; by E. J. Winslow at Barton Landing, Vt., 1905; by E. Brainerd at Middlebury, Vt., 1908 and 1909; and by H. G. Rugg, at Dorset, Vt., 1909.

The lack of resemblance of *Dryopteris Clintoniana × marginalis* to *D. Clintoniana* may perhaps be best defined as its suggestiveness of *D. marginalis* in outline of lamina, pinnae, and pinnulae, a suggestiveness which *D. Clintoniana* lacks altogether. Noticeable points of distinction from *Dryopteris Clintoniana* are the greater proportional breadth of the hybrid's leaf, its conspicuously attenuate apices, its color, nearer that of *D. marginalis,* the varying position of its sori, and its oblique often subfalcate pinnulae.

From *Dryopteris cristata × marginalis, D. Clintoniana × marginalis* may be most easily distinguished by the greater proportional breadth of the lower part of the lamina, coupled mostly with attenuate apices of all, even the basal, pinnae; by the position of

its sori, often nearer the midveins than in *D. cristata* × *marginalis;* and as a rule by its scales, which usually have dark centers, while those of *D. cristata* × *marginalis* appear uniformly light brown, so far as observed. But dark-centered scales do occur sometimes in *D. marginalis*, so are to be looked for in any of its hybrids. They are common in *Dryopteris marginalis* × *spinulosa* (*D. pittsfordensis*).

In 1902 Mr. George E. Davenport described in Rhodora * an anomalous plant as baffling identification, but suggested it might prove to be *D. Clintoniana* × *marginalis.* I have seen only scraps of pinnae of this plant, and have not been able to find out if other specimens are now in existence. Neither these scraps nor the published description of the plant tallies with anything I have seen that appeared unmistakably *D. Clintoniana* × *marginalis*, and it does not seem probable that the plant can have been this hybrid.

I am indebted to Dr. Ezra Brainerd, Dr. Philip Dowell, Mr. Ralph C. Benedict, and Mr. Harold G. Rugg for the privilege of examining material.

NEW YORK CITY.

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* 4: 10–13.

Stemphylium Tritici sp. nov., associated with floret sterility of wheat

Flora W. Patterson

Among the fungi associated with floret sterility of wheat in the southwest, transmitted for identification to the Bureau of Plant Industry, was a *Stemphylium* sp., which appears not to have been described. It is of considerable pathological importance; some artificial inoculations resulted in producing 9 per cent. of sterile florets: * "In nature the *Stemphylium* was prevalent on the leaves of wheat and almost invariably present in diseased ovaries, through the tissues of which the mycelium ramifies and produces conidia on the surface."

Stemphylium Tritici sp. nov.

Hyphae decumbent, irregularly branched, fuliginous; fertile branches upright, closely septate, 4–5 μ in diameter; conidia muriform, catenulate, irregular, generally clavate, constricted slightly at the septa, 24–35 $\mu \times$ 12–15 μ, fuliginous, verrucose; isthmus short, 3–4 μ in diameter.

In living leaves and ovaries of *Triticum sativum*, in Texas and Oklahoma, U. S. A.

Hyphis decumbentibus, irregulariter ramosis, fuligineis; ramis fertilibus erectis, brevi-septulatis, 4–5 μ diam.; conidiis muriformibus, catenulatis, irregularibus, plerumque clavatis, ad septum leniter constrictis, 24–35 $\mu \times$ 12–15 μ, fuligineis, verruculosis, isthmis brevibus, 3–4 μ diam.

In foliis vivis et ovariis *Tritici sativi* in Texas et Oklahoma in Amer. bor.

Bureau of Plant Industry,
U. S. Department of Agriculture,
Washington, D. C.

* Edw. C. Johnson. Floret sterility of wheat in the southwest. Paper read before the American Phytopathological Society, at Boston, Dec. 31, 1909.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1910)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

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BULLETIN

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Sphaerocarpos hians sp. nov., with a revision of the genus and illustrations of the species

CAROLINE COVENTRY HAYNES

(WITH PLATES 25–32)

While studying a remarkable *Sphaerocarpos* from the state of Washington, under the direction of Dr. Marshall A. Howe, the writer became gradually acquainted with the other species of this genus of Hepaticae. In the course of this study a considerable amount of material has been available and it has thus been possible to figure and describe all of the known species of *Sphaerocarpos*. The previous literature relating to the genus, especially the works of Nees von Esenbeck, Professor D. H. Campbell, Dr. Howe, and Professor Charles Douin, has been freely consulted and drawn upon. It is hoped that the information thus brought together and the conclusions drawn from it may be of some service to future students of the genus. For living material I am indebted to Professor C. Massalongo, of Ferrara, Italy, and to Professor Francis E. Lloyd, of Auburn, Alabama; freshly collected specimens, also, I owe to the kindness of Professor R. S. Cocks, of New Orleans, Louisiana. Through the courtesy of Monsieur Hariot, I was enabled to examine an authentic specimen of *S. stipitatus* from the herbarium of the Muséum d'Histoire Naturelle of Paris, our illustrations of this species being drawn from it. I must acknowledge, also, my obligations to Professor Douin, of Chartres, France, for numerous pockets of the two French species in various stages of development; to Dr. E. Levier, of Florence,

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Italy, for excellent specimens from Sardinia and various Italian stations. One of the last mentioned, from Florence, the home of the illustrious Micheli, the author of the name *Sphaerocarpos* and the first botanist to figure and describe one of the species of this genus, has been drawn upon to furnish illustrations of the generic type species. Mr. William E. Nicholson, of Lewes, Sussex, England, has kindly communicated an English specimen of the best known European species. In addition to those already named, one hundred and nine specimens have been examined in the following herbaria: that of the New York Botanical Garden (including those of L. M. Underwood and William Mitten), that of the Sullivant Moss Society, and that of the writer (including that of M. A. Howe).

Miss Lucy MacIntyre and Miss Julia T. Emerson have obligingly aided in making certain translations.

One of the results of this study is to exclude *S. Sphaerocarpos* (*S. terrestris* and *S. Michelii* of authors) from America, as no American specimen has been seen which seems to conform strictly to the characters of this European and possibly North African species. On the other hand, *Sphaerocarpos texanus* (*S. californicus* of authors) appears to have a very wide distribution, specimens from South America, Europe, and Mediterranean Africa being indistinguishable from those of the southern and western United States.

Stephani* gives the following seven species as belonging to the genus *Sphaerocarpos*: *S. terrestris* (Mich.) Smith, *S. Donnellii* Aust., *S. texanus* Aust., *S. Berteroi* Mont., *S. californicus* Aust., *S. cristatus* Howe, and *S. Jamesii* Aust. The last mentioned, Stephani states, was known to him by name only, a specimen being nowhere preserved, though, he adds, it was collected in Mexico. As no reference to such a species has been found in literature, and as Herr Stephani has been unable to give us any clue as to the place of origin of the name, it has been dropped from the list. *Sphaerocarpos texanus* appears to be indistinguishable from *S. californicus*, and, as *S. texanus* was published two years earlier, that name has been adopted. On somewhat similar grounds, though in this case the two names were based on speci-

* Bull. Herb. Boiss. 7: 656, 657. 1899.

mens from the same locality, *Sphaerocarpos stipitatus* Bisch. replaces *S. Berterii* Mont. (*S. Berteroi* of Stephani's Species Hepaticarum). To the five species thus remaining from Stephani's list, a sixth, the new species from the state of Washington, alluded to at the outset of this paper, is added below.

It should be remarked, perhaps, that *Sphaerocarpos Notarisii*, Mont.* was, a few years after its publication, referred by Montagne to its proper genus *Riella*.

The species of *Sphaerocarpos* are certainly among the simplest and most interesting of the Hepaticae and the importance of the genus from the evolutionary and phylogenetic point of view is clearly set forth in the following quotation from Professor Campbell :†

"From a review of the preceding account of the Liverworts, it will be apparent that these plants, especially the thallose forms, constitute a very ill-defined group of organisms, one set of forms merging into another by almost insensible gradations, and this is not only true among themselves, but applies also to some extent to their connection with the Mosses and Pteridophytes. The fact that the degree of development of gametophyte and sporophyte does not always correspond makes it very difficult to determine which forms are to be regarded as the most primitive. Thus, while *Riccia* is unquestionably the simplest as regards the sporophyte, the gametophyte is very much more specialized than that of *Aneura* or *Sphaerocarpus*. The latter is, perhaps, on the whole the simplest form we know, and we can easily see how from similar forms all of the other groups may have developed. The frequent recurrence of the two sided apical cell, either as a temporary or permanent condition in so many forms, makes it probable that the primitive form had this type of apical cell. From this hypothetical form, in which the thallus was either a single layer of cells or with an imperfect midrib like *Sphaerocarpus*, three lines of development may be assumed to have arisen. In one of these the differentiation was mainly in the tissues of the gametophyte, and the sporophyte remained comparatively simple, although showing an advance in the more specialized forms. The evolution of this type is illustrated in the germinating spores of the Marchantiaceae, where there is a transition from the simple thallus with its single apical cell and smooth rhizoid to the complex thallus of the mature gametophyte. In its earlier phases it resembles closely the condition which is permanent in the simpler anacrogynous Jungermanniaceae, and it seems more probable that forms like these are primitive than that they have been derived by a reduction of the tissues from the more specialized thallus of the Marchantiaceae. *Sphaerocarpus*, showing as it does points of affinity with both the lower Marchantiales and the anacrogynous Jungermanniales, probably represents more nearly than any other known form this hypothetical type. Its sporogonium, however, simple as it is, is more perfect than that of *Riccia*, and if our hypothesis is correct, the Marchantiales must have been derived from *Sphaerocarpus*-like forms in which the sporophyte was still simpler than that of existing species. Assuming that this is correct, the further evolution of the Marchantiales is simple enough, and the series of forms from the lowest to the highest very complete."

"In the second series, the Jungermanniales, starting with *Sphaerocarpus*, the line leads through *Aneura*, *Pellia*, and similar simple thallose forms, to several types with more or less perfect leaves — e. g., *Blasia*, *Fossombronia*, *Treubia*, *Haplomitrium*. These do not constitute a single series, but have evidently developed independently, and it is quite probable that the typical foliose Jungermanniaceae are not all to be traced

* In De Not. Mem. R. Accad. Torino II. 1 : 343. *f. d. 1–8.* 1839.

† Campbell, D. H. The structure and development of mosses and ferns 157–159. 1905. [ed. 2.]

back to common ancestors, but have originated at different points from several anacrogynous prototypes."

"The systematic position of the Anthocerotes is more difficult to determine, and their connection with any existing forms known must be remote. While the structure of the thallus and sporogonium in *Notothylas* shows a not very remote resemblance to the corresponding structures in *Sphaerocarpus*, it must be remembered that the peculiar chloroplasts of the Anthocerotes, as well as the development of the sexual organs, are peculiar to the group, and quite different from other Liverworts. To find chloroplasts of similar character, one must go to the green Algae, where in many Confervaceae very similar ones occur. It is quite conceivable that the peculiarities of the sexual organs may be explained by supposing that those of such a form as *Sphaerocarpus*, for example, should become coherent with the surrounding envelope at a very early stage, and remain so until maturity. In *Aneura* we have seen that the base of the archegonium is confluent with the thallus, in which respect it offers an approach to the condition found in the Anthocerotes; but that this is anything more than an analogy is improbable. The origin of the endogenous antheridium must at present remain conjectural, but that it is secondary rather than primary is quite possible, as we know that occasionally the antheridium may originate superficially. In regard to the sporogonium, until further evidence is brought forward to show that *Notothylas* may have the columella absent in the early stages, it must be assumed that its structure in the Anthocerotes is radically different from that of the other Liverworts. Of the lower Hepaticae *Sphaerocarpus* perhaps offers again the nearest analogy to *Notothylas*, but it would not be safe at present to assume any close connection between the two. Of course the very close relationships of the three genera of the Anthocerotes among themselves are obvious."

"On the whole, then, the evidence before us seems to indicate that the simplest of the existing Hepaticae are the lower thallose Jungermanniales, and of these *Sphaerocarpus* is probably the most primitive. The two lines of the Marchantiales and Jungermanniales have diverged from this common ancestral type and developed along different lines. The Anthocerotes cannot certainly be referred to this common stock, and differ much more radically from either of the other two lines than these do from each other, so that at present the group must be looked upon as at best but remotely connected with the other Hepaticae, and both in regard to the thallus and sporophyte has its nearest affinities among certain Pteridophytes. The possibility of separate origin of the Anthocerotes from *Coleochaete*-like ancestors is conceivable, but it seems more probable that they have a common origin, very remote, it is true, with the other Liverworts. They may probably best be relegated to a separate class, coördinate with the Hepaticae and Musci"

Those who follow the Vienna Rules of nomenclature will scarcely be inclined to deny that the first effective post-1753 publication of the genus *Sphaerocarpos* is found in Boehmer's edition of Ludwig's Definitiones Generum Plantarum, dated 1760. Strict adherents of the "American Code," however, may discover that *Sphaerocarpos* was not here used in connection with a specific name and that it is not "associable by citation with a *previously published* binomial species." But Ludwig's reference to Micheli, the real founder of the genus, makes the application of the generic name and the type of the genus indisputable. Adanson, who appears to have been the next author to mention the genus, changing the spelling of the final syllable to *us*, meets the American requirements of effective publication no more closely than does Ludwig. The name, in the Michelian sense, appears not to have been used in the binomial form until 1792, though, meanwhile,

the name had been appropriated by Bulliard for a genus of Myxomycetes and by Gmelin for a genus of seed-plants. The Michelian genus, however, was soon generally recognized and its acceptance has been so universal that no synonyms for it are to be found in the literature of the Hepaticae. To attempt at this time to rename on account of a possible slight technical flaw a genus so adequately established by Micheli (even though overlooked by Linnaeus) would seem an act of violence to the spirit, at least, of the priority principle. It may be remarked that *-os* and not *-us* is the ending of the generic name as used both by Ludwig and by its originator Micheli, and that there are the same grounds for adopting it as in the case of *Symphoricarpos*, in which that termination has already become familiar. In fact, the retention of the *-os* ending, it would appear, has been made mandatory by both the Vienna Rules (Art. 57) and the "American Code" (Part III, Section I)

SPHAEROCARPOS (Mich.) Ludwig, Def. Gen. Pl. 501. 1760.—
Mich. Nov. Pl. Gen. 4. *pl. 3.* 1729

Sphaerocarpus Adanson, Fam. Pl. **2**: 14. 1763

Gametophores thallus-like, dioicous, annual, small, orbicular to oblong or cuneate, simple or finally once to several times furcate, the broad multistratose midrib passing gradually into the lateral enfolding or inflexed unistratose lobes, intercalary subapical lobes at length nearly equaling the lateral. Cells of gametophore thin-walled, quadrate to long-pentagonal and hexagonal, without trigones. Rhizoids hyaline, smooth, thin-walled, numerous. Sexual organs thickly aggregated along the midrib of dorsal surface of thallus. Antheridial plants minute, scarcely visible to the unaided eye, tinged with purple; antheridia oval, short-stalked, their involucres flask-shaped. Archegonial involucres tubular or clavate to pyriform or subglobose, sessile or long-stipitate. Calyptra ruptured early, a portion with shriveled archegonium-neck long persisting on the apex of capsule. Sporogonium consisting of a globose capsule, an obsolescent stalk, and a bulbous foot,* the last often remaining in the thallus after the detachment of the capsule. Capsule indehiscent, its wall

* The brood-bodies or gemmae mentioned by various authors, among whom Bischoff gave the best description with figure, this latter being copied by Pearson, are probably to be identified with the bulbous detached basal parts of the sporogonia, which in some species remains in thallus. The "grünlichen drüsenartigen Körper" mentioned and figured by Sprengel (Anleit. Kennt. Gewachse 318. *f. 78.* 1804) are perhaps the oil-bodies which occur here and there in the thallus of *Sphaerocarpos*.

consisting of a single layer of cells destitute of spiral, annular, or other local thickenings. Spores permanently united in tetrads with two exceptions, *S. Donnellii*, in which they become free at full maturity and *S. cristatus*, in which they separate early in the development of the sporogonium; spore-tetrads, when persistent, distinctly areolate, appearing crenulate, papillate or subechinulate in optical section; spores, when separate, compressed-tetrahedral, rounded-lenticular, or sometimes concavo-convex, areolate or cristate, in *S. Donnellii* prominently tuberculate in the basilar circumference. Accompanying the spore mother-cells are smaller starch-bearing sterile cells probably equivalent to elaters morphologically, but lacking a spiral band, these more or less shriveled and obscure at the maturity of the spores.

Type species, *Sphaerocarpos Sphaerocarpos* (Dicks.) M. A. Howe.

Key to the species of Sphaerocarpos

♀ involucre sessile or subsessile.
- Spores permanently united in tetrads.
  - ♀ involucre contracted at the apex, the diameter of its orifice much less than that of the involucre; spore-tetrad regularly areolate.
    - ♀ involucre pyriform, obovoid, or subglobose; meshes of spore-tetrad 7–15 μ in diameter, the separating ridges low except at their intersections where they are raised into very acute or acicular spicules. — 1. *S. Sphaerocarpos.*
    - ♀ involucre tubular, fusiform-clavate, or rarely subpyriform; meshes of spore-tetrad 15–30 μ in diameter, the separating ridges usually high, sinuous, crenulate, or dissected, or sometimes raised to blunt spines at their intersections. — 2. *S. texanus.*
  - ♀ involucre wide-mouthed, the diameter of its orifice equaling or often exceeding that of the subjacent part of the involucre. — 3. *S. hians.*
- Spores separating at maturity, 85–138 μ in maximum diameter, areolate, each while united in the tetrad commonly showing a prominent protuberance about 12 μ high in middle of outer face, and after separation exhibiting a coarsely lobed basilar margin. — 4. *S. Donnelli.*
- Spores separating long before maturity, 52–80 μ in maximum diameter, typically cristate, less commonly irregularly and sparingly areolate. — 5. *S. cristatus*

♀ involucre distinctly stipitate. — 6. *S. stipitatus.*

1. SPHAEROCARPOS SPHAEROCARPOS (Dicks.) M. A. Howe, Mem. Torrey Club 7: 66. 1899. [With the *-us* ending.]

Targionia Sphaerocarpos Dicks. Pl. Crypt. 1: 8. 1785.—D.C. Fl. Fr. 2: 419. 1815.—Poll. Fl. Veron. 3: 399. 1824.

Sphaerocarpos terrestris, minima Mich. Nov. Pl. Gen. 4. *pl. 3.* 1729. — Dill. Hist. Musc. 536. *pl. 78. f. 17.* 1741.

Sphaerocarpos Michelii Bell. App. ad Fl. Pedem. 52. 1792 (*fide auctorum*); Mém. Acad. Roy. Sci. Turin **5**: 258. 1793; Usteri Ann. Bot. **15**: 87. 1795.

Sphaerocarpus terrestris J. E. Smith, Eng. Bot. *pl. 299.* 1796. — Bisch. *p. p.* Nova Acta Acad. Leop.-Car. Nat. Cur. **13**: 829–838. *pl. 44.* 1827. — Lindenb. *p. p.* Nova Acta Acad. Leop.-Car. Nat. Cur. **18**: 496. *pl. 36.* 1836. — Nees, *p. p.* Naturgesch. Europ. Leberm. **4**: 365. 1838. — Stephani, *p. p.* Bull. Herb. Boiss. **7**: 656. 1899. — Pears. *p. p.* Hep. Brit. Is. 482. *pl. 215. f. 1–14.* 1902. — K. Müller, in Rabenh. Krypt.-Fl. Deutschl. Oesterr. & Schweiz **6**: 316. *f. 190, 191.* 1907. — C. Douin, Rev. Bryol. **30**: 44–57. *f. 8–21.* 1903; **34**: 105–112. *f. 1–3, 11, 15.* 1907; **36**: 37–41. *f. 1–3, 5, 6, 8.* 1909.

Sphaerocarpus lagenarius Dumort. Comm. Bot. 78. 1822.

Sphaerocarpus utriculosus Dumort. *loc. cit.*

Sphaerocarpus terrestris, β? utriculosus Dumort. Hep. Eur. 164. 1874.

Archegonial thallus orbicular to obovate, 0.6 –13 mm. in diameter, densely cespitose, bright green when living, yellowish brown when dried, forking several times, lobes short, orbicular, margin ascending or incurved, marginal cells generally quadrate, 33–66 μ; archegonial involucres 1.5–2.5 mm. high, sessile, thickly crowded together so as almost entirely to conceal the thallus, pyriform, obovoid, or subglobose, orifice small, cells at orifice creniform, quadrate or oblong, 66–85 μ × 39–59 μ: antheridial thallus cuneate to orbicular, 1 mm. in diameter, the rounded lobes curving over the involucres, these 260–330 μ in height, purplish: capsule averaging 750 μ in diameter, the bulbous foot remaining in thallus on detachment of capsule; spores permanently united in tetrads, these 90–120 μ in diameter, greenish or brownish black, finely and regularly areolate, meshes small, 7–15 μ in diameter, each, occasionally, with a single median papilla, ridges low excepting at points of intersection, where they are raised into very acute or acicular spicules, these 7–12 μ in height. [PLATE 25.]

HABITAT: Damp sandy clay; "in clover fields" (England).

TYPE LOCALITY: Florence, Italy.

DISTRIBUTION: Italy, France, Germany, England, and Pantelleria Island (between Sicily and Tunis).

SPECIMENS EXAMINED: Five specimens from Italy, sent by Dr. E. Levier; living specimens from Ferrara, Italy, sent by Professor C. Massalongo; eight specimens from France, sent by Professor C. Douin; a specimen from Baden (between Grötzingen and Weingarten), collected by A. Kneucker; and a specimen from England, collected by W. H. Burrill, and communicated by Mr. William E. Nicholson.

Adherents of the Vienna Rules will use the name *Sphaerocarpos Michelii* for this species, while for those who follow the "American Code," its legal name is clearly that adopted above.

The areolae of the spore-tetrads of this species occasionally show an isolated median papilla or tubercle (see PLATE 25, FIGURE 12). This peculiarity is so pronounced and constant in certain collections that the possibility of its proving a diagnostic character of an unrecognized species at first suggested itself, but it soon became apparent that this character is sometimes only slightly developed (PLATE 25, FIGURE 10) and also that *S. texanus* shows a parallel series of forms (PLATE 27, FIGURES 11 and 15). It may be mentioned, however, that the spicules of some of these peculiar spore-tetrads with unipapillate areolae are less sharply pointed than is normal in *S. Sphaerocarpos*, approaching the blunt spines of certain forms (PLATE 27, FIGURES 19 and 21) which we are inclined to refer to *S. texanus*.

2. SPHAEROCARPOS TEXANUS Aust. Bull. Torrey Club **6**: 158. 1877.—Underw. Bull. Illinois State Lab. Nat. Hist. **2**: 30. 1884.—Stephani, Bull. Herb. Boiss. **7**: 656. 1899.

Sphaerocarpus terrestris Bisch. *p. p.* Nova Acta Acad. Leop.-Car. Nat. Cur. **13**: 829–838. *pl. 44.* 1827.—Lindenb. *p.p.* Nova Acta Acad. Leop.-Car. Nat. Cur. **18**: 496. *pl. 36.* 1836. —Nees, *p. p.* Naturgesch. Europ. Leberm. **4**: 365. 1838.—Pears. *p. p.* Hep. Brit. Is. 482. *pl. 215. f. 1–14.* 1902.—Stephani, *p. p.* Bull. Herb. Bois. **7**: 656. 1899.

Sphaerocarpus Berterii Aust. Hep. Bor.-Am.: Tickets of the specimens 34. 1873. Not *S. Berterii* Bisch.

Sphaerocarpus californicus Aust. Bull. Torrey Club **6**: 305. 1879.—M. A. Howe, Mem. Torrey Club **7**: 65. *pl. 100. f. 9–12.*

1899. — Stephani, Bull. Herb. Boiss. 7: 657. 1899. — K. Müller, in Rabenh. Krypt.-Fl. Deutschl. Oesterr. & Schweiz 6: 317. *f. 192.* 1907. — Douin, Rev. Bryol. 34: 105–112. *f. 4–10, 12, 13, 14.* 1907; 36: 37–41. *f. 4, 7, 10.* 1909.

Sphaerocarpus Michelii Underw. *p. p.* Bull. Illinois State Lab. Nat. Hist. 2: 30. 1884.

Sphaerocarpus Michelii californicus (Aust.) Underw. *l. c.*

Archegonial thallus suborbicular or somewhat cuneate, 3–5 mm. × 4–8 mm., densely cespitose, bright green when living, dingy green or sometimes light olive-green when dried, forking several times, the leaf-like unistratose lobes almost entirely concealed by the overcrowding of the involucres, marginal cells generally quadrate, averaging 45 μ; archegonial involucres 1.2–2.6 mm. high, sessile, long-cylindrical, fusiform-clavate, very rarely subpyriform, more or less acuminate, cells at small orifice usually creniform, 45–60 μ: antheridial thallus oblong to orbicular, 2 mm. in diameter, forking several times, the lobes more conspicuous than those of the archegonial plant; antheridial involucres 270–360 μ high, purplish: capsule averaging 675 μ in diameter, the bulbous foot remaining in thallus on detachment of capsule; spores permanently united in tetrads, these 72–171 μ in diameter, golden-brown to dark opaque-brown, regularly areolate, minutely granulate, meshes 13–30 μ in diameter, each, in rare cases, with a single median papilla or tubercle, the ridges finally high, sinuous, crenulate, or deeply and irregularly dissected, occasionally forming obtuse spines at the points of intersection. [PLATES 26 and 27.]

HABITAT: On flat compact commonly lightly shaded soil in meadows and orchards and beside paths.

TYPE LOCALITY: San Marco, Texas.

DISTRIBUTION: United States, Uruguay, England, France, Germany, Sardinia, and Northern Africa (Tangier).

EXSICC: Hep. Bor.-Am. *no. 138*, as *S. Berterii* (in herb. New York Botanical Garden). — Hep. Brit. *no. 215*, as *S. terrestris* (in herb. Underwood). — Hep. Europ. *no. 21*, as *S. terrestris* (in herb. Underwood).

An examination of mature specimens of *Sphaerocarpos* from various parts of the United States leads to the conclusion that the plant described by Austin as *S. texanus* in 1877 cannot be satisfactorily distinguished from the plant that he described as *S. californicus* two years later. The latter name is therefore considered a synonym of the former. Austin himself seems at first to have

considered them the same, for in his Hep. Bor.-Am. (Tickets of the specimens, 34. 1873) he cites under "*138. Sphaerocarpus Berteri*" the following stations: "California, *Bolander*, *Bigelow*; Texas, *Wright*." Later he recognized his error in identifying these plants with the very different South American species and described the Texan specimens as *S. texanus* Aust. and the Californian as *S. californicus* Aust. Herr Stephani remarks (Bull. Herb. Boiss. 7: 656. 1899) that he had not seen *S. texanus*, that it is not preserved in Austin's herbarium in Manchester, that the plant seems to be wholly lost, but that the very small spores ("coccus 63 μ") will make possible its recognition. It has been my good fortune to examine three specimens of *S. texanus* collected by Wright in Texas and now preserved in the herbaria of the New York Botanical Garden and of Columbia University. Two of these came from the Underwood herbarium, one of them being labeled "*Sphaerocarpus texanus* Aust. (type?), San Marco, Tex., C. Wright, 1849, ex coll. W. H. Pearson 1894," and the other "*Sphaerocarpus texanus*, San Marco, Texas, C. Wright, 1849, ex Sulliv." The third is in the herbarium of Columbia University, is labeled "*Sphaerocarpus texanus* Aust. Texas, leg. Wright, ex herb. Aust.," and was communicated by W. H. Pearson in 1890. Austin, in connection with the original description of *S. texanus*, compares it with "*S. Michelii*," stating the *S. texanus* is distinguished by its smaller frond, its involucre less obtuse at the apex, and the spores almost a half smaller. The coccus is described as about 1/400 of an inch (62.5 μ) in diameter, while that of *S. Michelii* is 1/200–1/250 of an inch in diameter. The present writer finds the chief differences separating *S. texanus* from *S. Sphaerocarpos* (*S. Michelii*) to lie in the more pointed fusiform-clavate rather than obovoid involucres, in the meshes of the surface of the spore-tetrads being nearly twice as wide, and in the high ridges forming these meshes being sinuous or crenulate-margined or irregularly dissected, or occasionally rising into obtuse spines at the points of intersection, but never forming sharp needle-like spines as in *S. Sphaerocarpos*. I have not been able to find in the Texan material collected by Wright any spore-tetrads as small as those described by Austin, the smallest seen measuring 72 μ. There is, however, a surprising variation in the size of the tetrads

even on a single plant: those in one capsule measured 72–99 μ, while those in another capsule on the same plant measured 92–132 μ; these two sets of spore-tetrads were about equally brown, but the smaller had smaller meshes and lower ridges and it is probable that the plant was killed before these smaller ones had reached full maturity.

As indicated above, *Sphaerocarpos texanus* seems to have a wider distribution than any other species of the genus.

It is of interest to note that the classical descriptions of *S. terrestris* given by Bischoff,* by Lindenberg,† and by Nees ‡ were based, in large part at least, on specimens collected at various times in vineyards near Durlach, Karlsruhe, Baden, by A. Braun. Now it proves that copious specimens collected by A. Braun in this locality in 1834 (the 1834 collection is mentioned by Nees) and preserved in the Mitten Herbarium are clearly *S. texanus* Aust. (see PLATE 27, FIGURE 17), and it may be said that some of the figures published by Bischoff and by Lindenberg point to *S. texanus* rather than to *S. Sphaerocarpos.* It is to be added, however, that the genuine *S. Sphaerocarpos* (*S. terrestris*)—beautifully distinct—also occurs in Baden and near Karlsruhe, as is attested by specimens collected by A. Kneucker on April 21st, 1894, in vineyards between Grötzingen and Weingarten (see PLATE 25, FIGURE 8), and it is possible that both species were represented in the material obtained by Professor Braun.

3. **Sphaerocarpos hians** sp. nov.

Archegonial thallus oblong or orbicular, 4–6 mm. in diameter, growing in isolated groups, bright green when dried, margin lobed and crispate, ascending, marginal cells generally quadrate, averaging 47 μ; archegonial involucres 1–2 mm. high, sessile, not crowded together or entirely concealing the thallus, tubular-ovoid, sometimes slightly larger at apex and slightly flaring, orifice large, of the diameter of the involucre or larger, irregular and entire, cells at orifice $26 \times 39 \mu$, with thick walls: antheridial thallus cuneate to orbicular, 2 mm. in diameter, forking several times, the leaf-like lobes curved over the involucres, these 243–398 μ in height, green becoming brown and purplish with age, their cells,

*Nova Acta Acad. Leop.-Car. Nat. Cur. 13: 829–838. *pl. 44.* 1827.

† *Loc. cit.* 18: 496. *pl. 36.* 1836.

‡ Naturgesch. Europ. Leberm. 4: 365–369. 1838.

especially those of the neck, thin-walled and nonprotuberant: capsule averaging 587 μ, the bulbous foot remaining attached to capsule; spores permanently united in tetrads, these 66–83 μ in diameter, golden-brown, cristate-reticulate, the crests sinuous, 5 μ high, delicate, somewhat elevated at the angles, occasionally crossing the boundaries of the spores, anastomosing irregularly, forming closed or partially closed meshes or occasionally running in parallel lines toward the boundaries of the spore, a blunt spine occurring now and then within the areolae, the margin in optical section appearing crenulate to tuberculate. [PLATE 28.]

HABITAT: Clayey places in copses; on bare alluvial soil in the shade of willows.

TYPE LOCALITY: Pullman, Washington.

DISTRIBUTION: Washington.

SPECIMENS EXAMINED: *C. V. Piper 91*, type, July 2, 1894, and July 21, 1894, both collected at Pullman, Washington, and preserved in the herbarium of the New York Botanical Garden.

This species resembles most closely *Sphaerocarpos cristatus*, differing markedly in the involucre being tubular with a wide or flaring orifice, instead of being subglobose with small orifice, and in the tetrads remaining permanently united, while in *S. cristatus* they separate long before maturity. The spore markings of the two species are somewhat similar, though those of *S. hians* show more regular reticulations.

4. SPHAEROCARPOS DONNELLII Aust. Bull. Torrey Club 6: 157. 1877. — Underw. Bull. Illinois State Lab. Nat. Hist. 2: 30. 1884. — Stephani, Bull. Herb. Boiss. 7: 656. 1899.

Archegonial thallus cuneate, averaging 9 mm. long and 6 mm. in greatest width, forming mats, dark green, faded green when dried, forking repeatedly, lobes large, explanate, margin sinuous, marginal cells generally oblong, 33 × 66 μ; archegonial involucres 2–2.3 mm. high, sessile, not crowded together, somewhat isolated, ovoid-ellipsoid, tubular, truncate at apex, orifice somewhat conspicuous, cells at orifice 39–46 μ: antheridial thallus cuneate, 3 mm. in maximum diameter, each of its five or six main divisions once or twice furcate, lobes large, leaf-like; antheridial involucres 448–996 μ in height, 3 times their diameter, red-brown, cells with somewhat thick walls: capsule averaging 724 μ in diameter, the bulbous foot remaining in thallus on detachment of capsule; spores separating at maturity; spore-tetrad averaging 145 μ in diameter just before separating, provided with a promi-

nence 12 μ in height near the middle of the outer face of each spore, this becoming shriveled at maturity; spores 85–138 μ in maximum diameter, yellow to opaque brown and regularly areolate, coarsely granulate, meshes large, 13–26 μ, the ridges wrinkled and sinuous, forming elevations at points of intersections of meshes, the spores after separation showing a conspicuous coarsely lobed basilar margin. [PLATES 29 and 30.]

HABITAT: Growing on damp sandy soil, in gardens, etc.

TYPE LOCALITY: Jacksonville, Florida.

DISTRIBUTION: Florida and Georgia.

EXSICC: Hep. Amer. *no. 61* (as *Sphaerocarpus terrestris* Mich.) and *no. 62* (as *Sphaerocarpus Donnellii* Aust.).

5. SPHAEROCARPOS CRISTATUS M. A. Howe, Mem. Torrey Club **7**: 66. *pl. 100. f. 1–8.* 1899. — Stephani, Bull. Herb. Boiss. **7**: 657. 1899

Archegonial thallus suborbicular, 3–8 mm. in diameter, pale green when dried, marginal lobes orbicular, ascending, marginal cells generally quadrate, 26–45 μ; archegonial involucres 0.85–1.2 mm. high, sessile, thickly aggregated, at first cylindrical, soon becoming subglobose or obovoid, rounded at apex, orifice small, cells at orifice creniform, 26–40 μ: antheridial thallus cuneate, 2 mm. in diameter, often once furcate, with oblong-ovate lobes; antheridial involucres 498–581 μ in height, about 2.5 times their diameter: capsule 500–800 μ in diameter, the bulbous foot remaining attached to capsule; spores separating long before the maturity of the capsule, never persisting in tetrads, compressed, rounded-biconvex or sometimes concavo-convex, yellowish brown or pale yellow, 52–80 μ in maximum diameter, cristate, the crests sinuous, 4–7 μ high, subcrenulate, mostly radiating from near the middle of each of the two faces, often 1–3 times furcate, sparingly anastomosing, forming sometimes 1–6 (rarely more) completely closed meshes in most cases near the middle of the face. [PLATE 31.]

HABITAT: On flat compact soil in meadows and beside paths.

TYPE LOCALITY: Near Stanford University, Santa Clara County, California.

DISTRIBUTION: California.

EXSICC.: Hep. Am. *no. 160* (as *S. terrestris*, var. *californicus* Aust.) [*S texanus*], a little of which is intermingled in some of the sets in the herbarium of the New York Botanical Garden).

This remarkable species is allied to *Sphaerocarpos hians* from Washington, from which it differs in having spores that separate

early instead of remaining permanently in tetrads, in its subglobose archegonial involucre with a small orifice, instead of being long-tubular with orifice the diameter of the involucre. In both of these species the foot remains attached to the capsule on the detachment of the latter from the thallus; the spore markings are somewhat similar. In *S. Donnellii*, the spores separate at maturity, their markings are areolate instead of typically cristate, and they are characterized by a coarsely lobed basilar margin.

The description and drawings published by Professor Campbell in his "Notes on *Sphaerocarpus*" (Erythea 4: 73–77. 1896) probably relate chiefly to this species.

6. SPHAEROCARPOS STIPITATUS Bisch.; Lindenb. Nova Acta Acad. Leop.-Car. Nat. Cur. 18: 504 i. *pl. 36.* 1836

Sphaerocarpus Berterii Mont. Ann. Sci. Nat. II. 9: 39. Ja 1838. — Nees, Naturgesch. Eur. Leberm. 4: 369. 1838. — Mont. & Nees, in d'Orbigny, Voy. Am. Mérid. 7^2: 50. 1839. — G. L. & N. Syn. Hep. 595. 1846. — Mont. Syll. Gen. Sp. Crypt. 95. 1846.

Sphaerocarpus Berteroi Stephani, Bull. Herb. Boiss. 7: 657. 1899.

Archegonial thallus suborbicular to oblong, 2 mm. in diameter, in thick cushion-like tufts, light green when dried, margin divided into 4–8 cuneate, ascending, somewhat undulating lobes, marginal cells generally quadrate, averaging 26–39 μ; archegonial involucres 1.5–2 mm. high, distinctly stipitate (the slender stipes 0.5–0.65 mm. long), tubular-ovoid, ellipsoidal, or bluntly conical, more or less narrowed to the truncate apex, fleshy, carnose-opaque, its wall apparently more than one cell thick, orifice large, of nearly the diameter of the involucre, setulose, the hyaline, thick-walled setulae mostly 2 cells long, incurved: antheridial thallus not seen: capsule 340–420 μ in diameter; the persistent spore-tetrads yellowish, coarsely areolate and somewhat roughened, marginate. [PLATE 32.]

HABITAT: Growing in moist places, on the border of ditches.

TYPE LOCALITY: Quillota, Chile.

SPECIMEN EXAMINED: B. Bertero, *695*, August and September 1829, in the herbarium of the Muséum d'Histoire Naturelle of Paris, France.

The description of the capsule and spores has been derived from literature mentioned above.

NEW YORK BOTANICAL GARDEN

Explanation of plates

PLATE 25. *Sphaerocarpos Sphaerocarpos*

1. ♀ plant, mature, × 14. 2. ♀ plant, immature, × 14. 3 and 4. ♂ plants, × 29. 5. Orifice of ♀ involucre, × 48. 6, 8, 10, and 12. Spore-tetrads, × 390. 7, 9, 11, 13. Spicules and ridges of spore-tetrads shown in optical section, × 390; 7 was drawn from spore shown in fig. 6; 9, from that shown in fig. 8; 11, from that shown in fig. 10; 13, from that shown in fig. 12.

Figures 1 and 5 were drawn from a specimen collected by O. Beccari, near Florence, Italy, 9 February, 1898; 2, 3, 4, 6 and 7, from a specimen collected by E. Bacci, near Florence, Italy, 9 March, 1888; 8 and 9, from a specimen collected by A. Kneucker, between Grötzingen and Weingarten, Baden, Germany, 21 April, 1894; 10 and 11, from a specimen collected by W. H. Burrill, Strumpshaw, E. Norfolk, England, April, 1908; 12 and 13, from a specimen collected by A. Mori, at Pisa, Italy, December, 1881 (Erb. Critt. Ital., ser. II, *no. 1201*).

PLATES 26 and 27. *Sphaerocarpos texanus*

1. ♀ plant, × 14. 2. ♂ plant, × 29. 3. Orifice of ♀ involucre, × 48. 4, 5, 7, 9, 11, 13, 15, 17, 19, and 21. Spore-tetrads, × 390. 6, 8, 10, 12, 14, 16, 18, 20, and 22. Ridges of spore-tetrads shown in optical section, × 390; 6 was drawn from spore shown in fig. 5; 8, from that shown in fig. 7; 10, from that shown in fig. 9; 12, from that shown in fig. 11; 14, from that shown in fig. 13; 16, from that shown in fig. 15; 18, from that shown in fig. 17; 20, from that shown in fig. 19; 22, from that shown in fig. 21.

Figures 1, 2, 4, 9, and 10 were drawn from specimens collected by C. Wright, at San Marco, Texas, 1849; 3, 7, and 8, from specimens collected by M. A. Howe, Mill Valley, California, 4 April, 1896 (in herb. Haynes); 5 and 6, from a specimen collected by J. Arechavaleta, *no. 151*, at Montevideo, Uruguay, August, 1876 (in herb. Mitten); 11 and 12, from a specimen collected by Welwitsch, *no. 28* [Portugal?] (in herb. Mitten); 13 and 14, from a specimen collected in Tangier in the winter of 1826 (in herb. Mitten); 15 and 16, from a specimen collected by H. A. Green, Chester, South Carolina, 4 March, 1886 (in herb. Haynes); 17 and 18, from a specimen collected by A. Braun, Durlach, Baden, March, 1834 (in herb. Mitten); 19 and 20, from a specimen labeled *S. Micheli*, herb. P. V. LeRoy, Florida (in herb. New York Botanical Garden); 21 and 22, from a specimen collected by Gennari in Sardinia, April, 1889.

PLATE 28. *Sphaerocarpos hians*

1. ♀ plant × 14. 2. ♂ plant, × 29. 3. Orifice of ♀ involucre, × 48. 4, 5, and 6. Spore-tetrads, × 390. 7. Ridges of spore-tetrad shown in optical section, × 390.

The figures were all drawn from the type specimen, collected by C. V. Piper, *no. 91*, Pullman, Washington, 2 July, 1894

PLATES 29 and 30. *Sphaerocarpos Donnellii*

1. ♀ plant, × 14. 2. ♂ plant, × 29. 3. Spore, showing outer face and coarsely lobed basilar margin. 4. Spore, showing tubercular prominence on outer face, in a lateral view, × 390. 5. ♂ plant, showing greatly elongated necks of involucres on old parts of thallus, × 48. 6. Spore-tetrad, nearly mature, × 390. 7. Ridges of spore and tubercular prominence shown in optical section, × 390. 8. Spore-tetrad beginning to separate, × 390. 9. Orifice of ♀ involucre, × 48.

Figure 1 was drawn from a specimen collected by Severin Rapp, in Florida, February, 1905; 5, from Hep. Am. *no. 61*; 2, 3, 4, 5, 6, 7, 8, and 9, from Hep. Am. *no. 62*.

PLATE 31. *Sphaerocarpos cristatus*

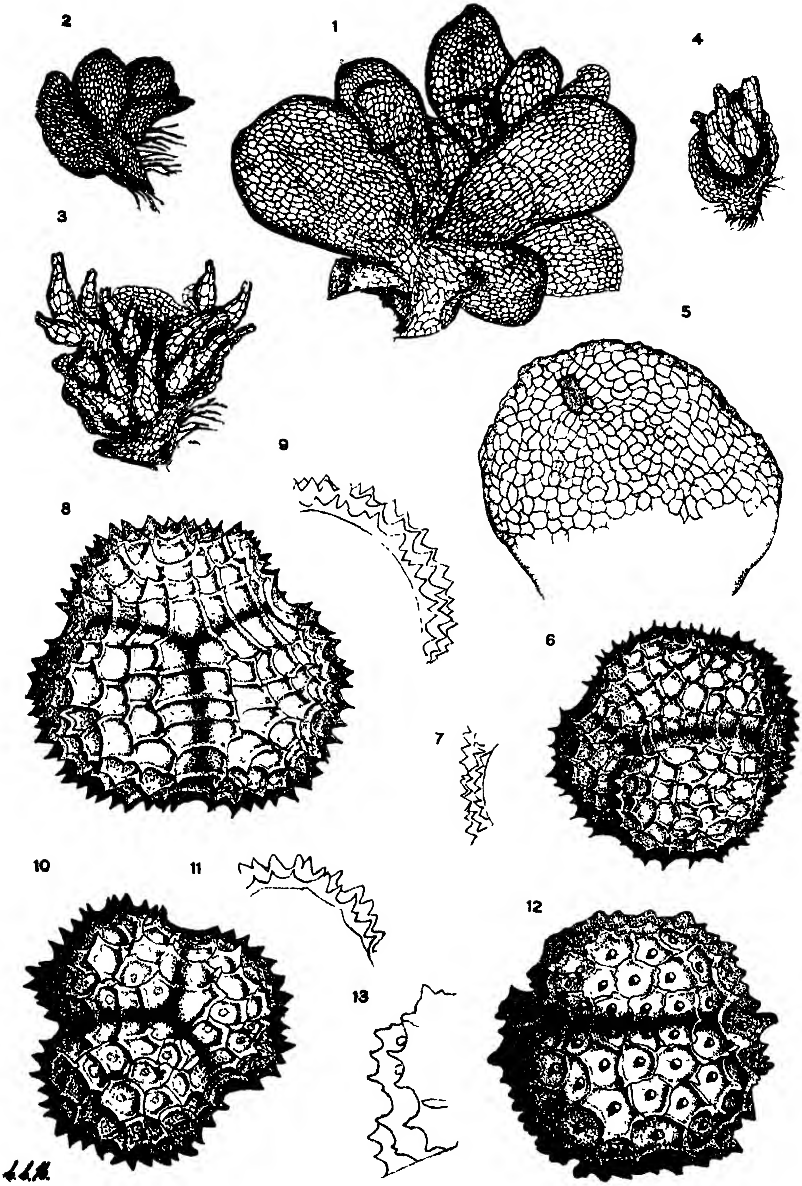
1. ♀ plant, × 14. 2. ♂ plant, × 29. 3. Orifice of ♀ involucre, × 48. 4, 5, 6, and 7. Spores, × 390.

The figures were all drawn from the type material.

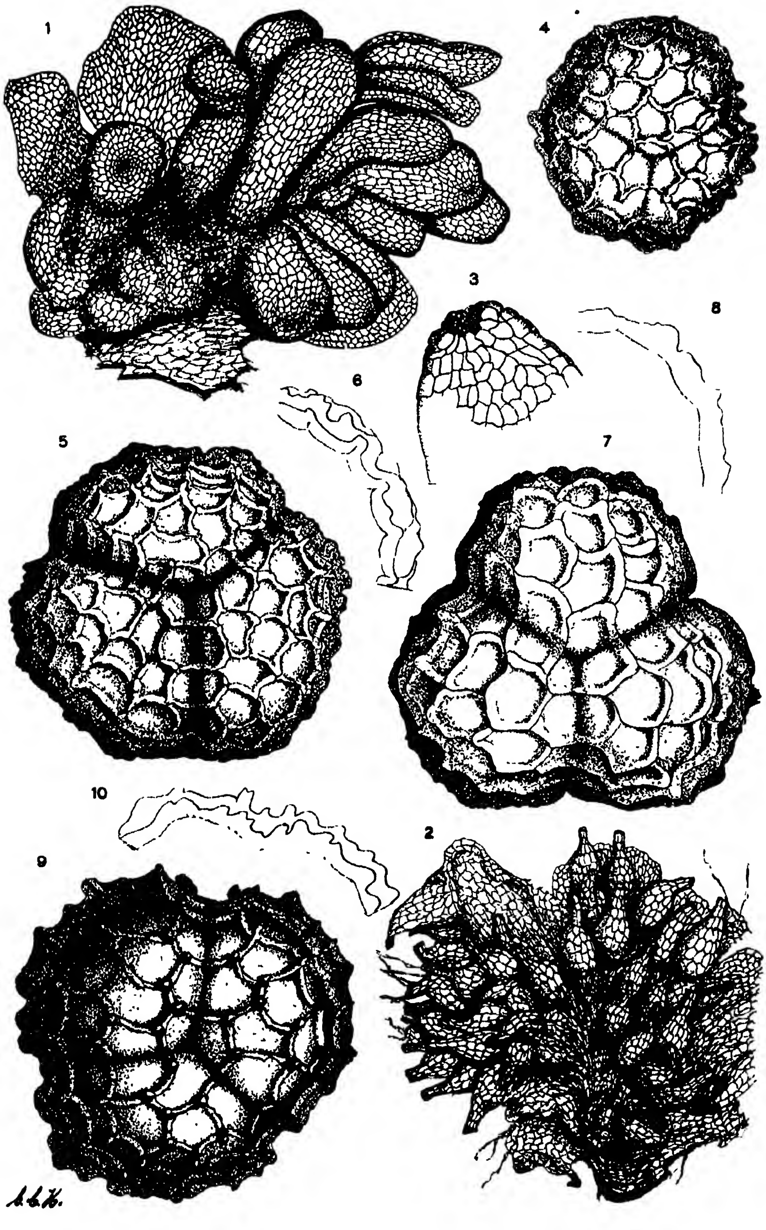
PLATE 32. *Sphaerocarpos stipitatus*

1. ♀ plant, immature, × 29. 2. ♀ involucre, × 14. 3. Orifice of ♀ involucre, showing setulae, × 120. 4 and 5. ♀ plants, × 14 (drawn to scale of other species). 6. Portion of sterile plant, × 14.

The figures were all drawn from material of the original collection preserved in the Muséum d' Histoire Naturelle of Paris.



SPHAEROCARPOS SPHAEROCARPOS (Dicks.) M. A. Howe



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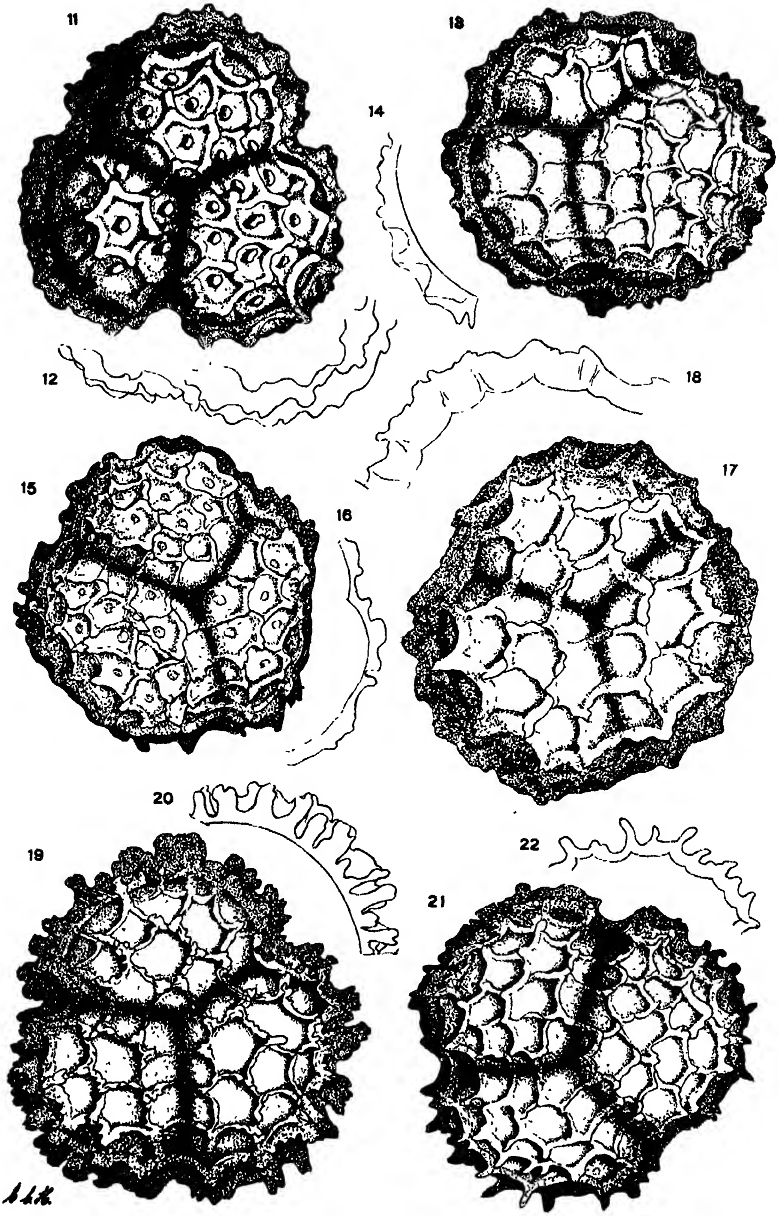
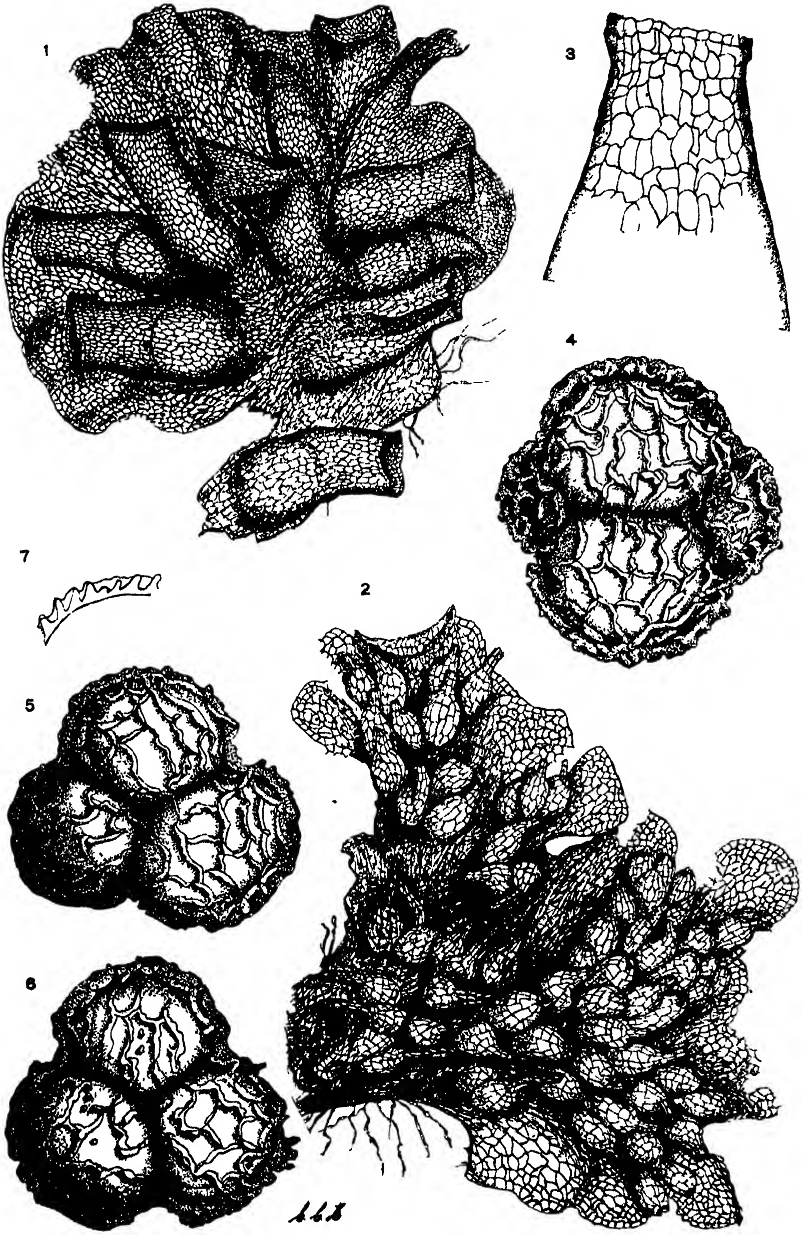
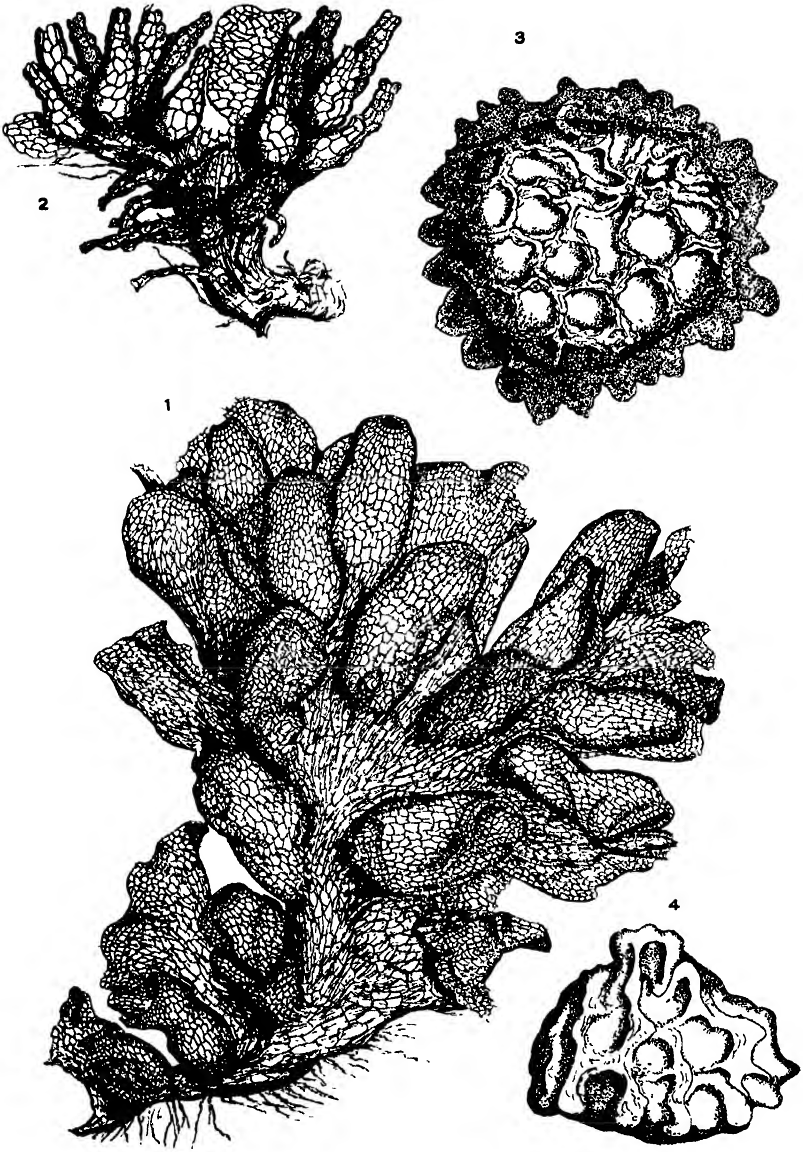


SPHAEROCARPOS TEXANUS Aust.



SPHAEROCARPOS HIANS Haynes



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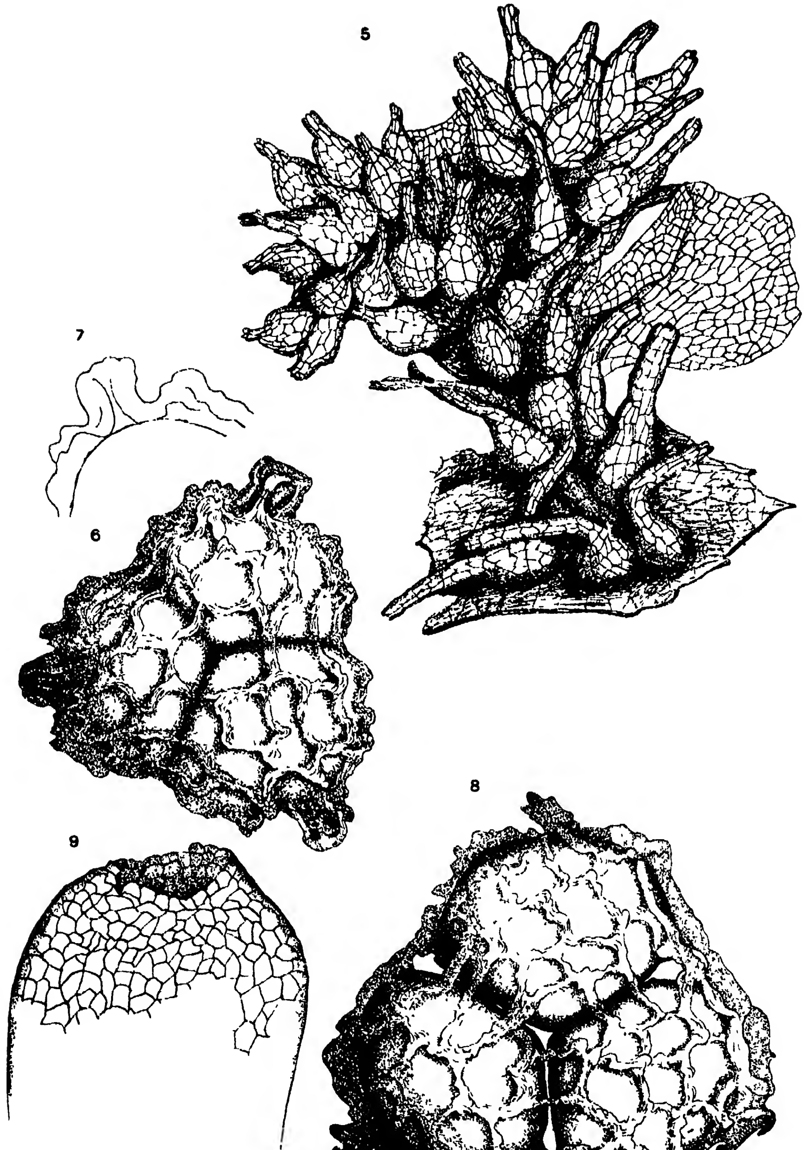

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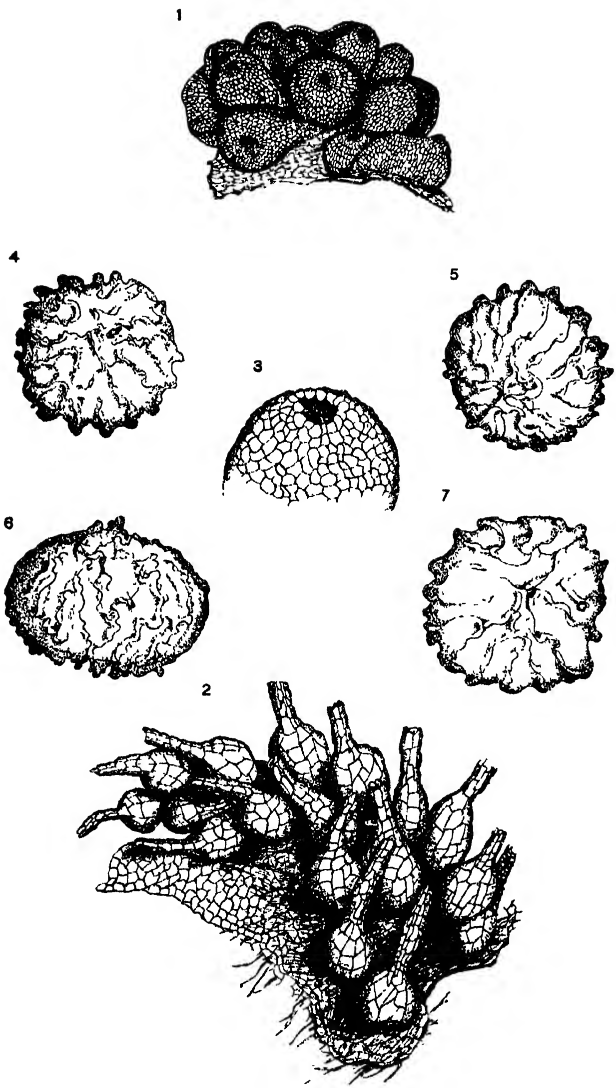

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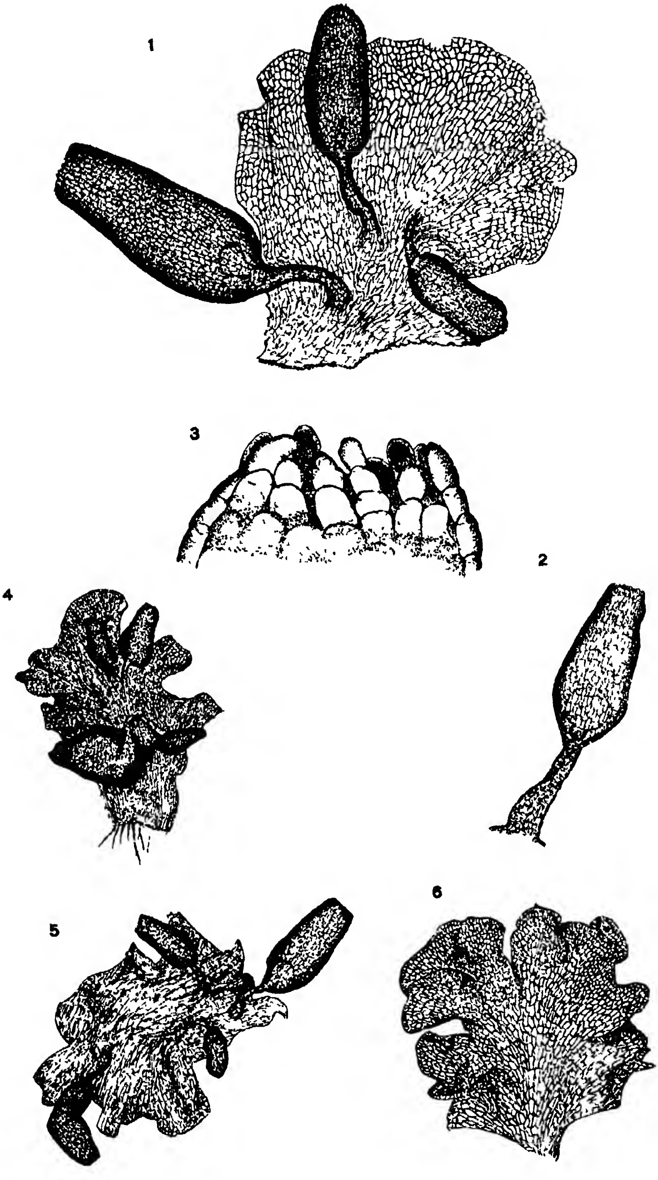
SPHAEROCARPOS CRISTATUS M. A. Howe



SPHAEROCARPOS STIPITATUS Bisch.

Notes on Carex — VI

KENNETH KENT MACKENZIE

CAREX TETANICA SCHK. AND ITS ALLIES

The above species, which is widely distributed in the northeastern part of the United States, has been the source of some diversity of opinion among botanists who have given special attention to our species of *Carex*. Like many other species, it shows a considerable amount of variation, and the perigynia, moreover, seem unusually variable. Several varieties or allied species have been from time to time proposed. But all of these, with the exception of *Carex Woodii* Dewey and *Carex Meadii* Dewey, have with good reason been relegated to synonymy.

I have gone carefully over the original description of *Carex Woodii* Dewey, as well as studied some of the original specimens (almost unrecognizable scraps) collected by Dr. Wood in Jefferson County, New York, and preserved in the New York Botanical Garden. From this study it seems to me that the plant is best treated as a slim form of *Carex tetanica* Schk., and is not worthy of recognition.*

Carex Meadii Dewey, on the other hand, seems to be clearly worthy of recognition. It is undoubtedly closely related to *Carex tetanica*, but holds its distinctive features over a large area of country. The two species are, moreover, readily told apart in large collections of herbarium material, and good specimens which cannot be referred at once to the proper one of these two species are very few in number.

The curious point, however, in dealing with this group is that there are certain local plants apparently but little collected which

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* Some old specimens in the Torrey Herbarium collected in Jefferson County, New York, by an unnamed collector and marked *Carex Woodii* are, however, *Carex colorata*, hereinafter described. It is possible that these represent *Carex Woodii*, but in the absence of any definite evidence I have preferred to regard the common slender form of *Carex tetanica* usually regarded as *Carex Woodii* as that plant. A good example of what I regard as *Carex Woodii* is a specimen collected June 17, 1902, by Rich, Williams & Fernald at Sudbury, Massachusetts.

are more worthy of separation than any of the plants already discussed. One of these plants from the region of the Great Lakes has long been in my collection under the name of *Carex tetanica* var. *Woodii* (Dewey) Bailey. Moreover, from the description and key it is without doubt the plant treated as *Carex tetanica* by Herr Kükenthal in the Pflanzenreich.† In that excellent work the key character used to separate *Carex livida* Wahl., and *Carex vaginata* Tausch from *Carex polymorpha* Muhl. and *Carex tetanica* Schk. (as there treated) is the following:

"Vaginae inferiores clare brunneae foliiferae"

"Vaginae inferiores purpureae aphyllae."

This key works excellently and brings out very characteristic features when applied to all the species except the real *Carex tetanica.* Any one examining it will soon see that both it and *Carex Meadii* have the lower sheaths conspicuously leaf-bearing and do not have the sheaths strongly purplish tinged. On the other hand the plant of the Great Lake region above referred to does exactly answer this description. Not only is this true but it further differs from the real *Carex tetanica* in being loosely stoloniferous. The stolons are stout for the size of the plant, are strongly purplish-tinged, and very readily pulled up. Contrasted with this, *Carex tetanica* has very deep-seated slender white running rootstocks. Any one who has ever collected the plant will know how hard and tedious an undertaking it is to get to these rootstocks. In fact it is so hard that most herbarium specimens do not show them at all. The plant of the Great Lake region is evidently worthy of recognition and is therefore here proposed as

Carex colorata sp. nov.

"*Carex tetanica* Schk." Kükenthal, in Engler, Pflanzenreich 4^{20}: 514. 1909.

Culms arising in loose stools, slender, 3–5 dm. high, aphyllopodic, strongly purplish-tinged at base, strongly stoloniferous, the stolons purplish-tinged and with loose sheaths, near the surface of the ground and readily pulled up, the culms usually noticeably

† After writing the above I was favored by Prof. Macoun with a loan of the specimens of this group from the herbarium of the Geological Survey of Canada, and found that the above statement is correct, Macoun's No. 33,639, the first specimen cited by Kükenthal under *C. tetanica*, not being that species but the species here described.

exceeding the leaves, roughened on the angles at least above, the sterile culms numerous. Leaves (not bracts) with well-developed blades usually two to four to a fertile culm, near the base but not bunched, the sheaths overlapping, rather loose, white- or yellowish-scarious opposite the blades, the ligule not prolonged, the blades flat, glabrate to minutely pubescent, the upper the larger, usually 2.5–4 mm. wide, 5–20 cm. long, strongly roughened; blades of sterile culm averaging much longer; terminal spike staminate, from but little to strongly peduncled, its peduncle smooth or little roughened, the spike linear, 1.5–3.5 cm. long, 2.5–4 mm. wide, the numerous closely appressed scales oblong-ovate, obtuse, purplish brown with green midrib and hyaline margins; pistillate spikes two or three, widely separate, erect on slender usually much exserted peduncles, the spikes linear, 1.5–3.5 cm. long, 3–4 mm. wide, loosely and alternately 6–15-flowered, the perigynia ascending; bracts leaflet-like, shorter than the culm, the sheaths 5–30 mm. long; scales obovate or ovate, obtuse or acutish, varying to acuminate or even cuspidate, wider than and about two thirds the length of mature perigynia, straw-colored or purplish brown with green midrib and hyaline margins; perigynia oblanceolate or fusiform, obtusely triangular, 3.5–4 mm. long, 1.5 mm. wide, lightly many-nerved, tapering to the base, tapering at apex into the minute slightly curving beak, 0.5 mm. long, the orifice oblique; achenes triangular, oblong, 2.5 mm. long, closely fitting the perigynia; stigmas three.

The type of the above species was collected by Mr. Charles K. Dodge at Port Huron, Michigan, on May 9, 1896, and is in my herbarium. A duplicate has been deposited in the herbarium of the New York Botanical Garden.

Other specimens of this species, all in the herbarium of the Geological Survey of Canada, except where otherwise stated, have been examined as follows:

ONTARIO: Guelph, *Klugh*, June 8, 1905 (K. K. M.); Sarnia, *Macoun 33639*, June 11, 1901 (referred by Kükenthal to *C. tetanica*); Wyoming, *Macoun 33740*, June 14, 1901; Galt, *Herriot 63112*, June 13, 1902; Belleville, *Macoun 31974*, June 15, 1862 (in part).

MICHIGAN: Michigan Agricultural College, *C. F. Wheeler*, June 5, 1900.

MANITOBA: Brandon, *Macoun 16662*, June, 1880; Grand Valley, Brandon, *Macoun 77117*, June 16, 1880.

NEW YORK: Jefferson Co. (Columbia Univ.).

The second plant referred to which seems worthy of separation is a plant of the mountains of North Carolina, distributed in considerable quantities in recent years by the Biltmore collectors. Like *Carex colorata* this species differs from *Carex tetanica* and *Carex Woodii* in not having the lower sheaths blade-bearing and in being strongly purplish-tinged at base. It, however, lacks the strong stolons so characteristic of *C. colorata*, but has stout, much interwoven and elongated rootstocks, like those of *Carex polymorpha*. In addition, it is a stout plant with broader leaf-blades. In fact it seems to be a local type characteristic of some of the higher country of North Carolina, and in honor of the institution which has distributed most of the specimens seen by me it is here proposed as

Carex biltmoreana sp. nov.

Culms arising in close stools from stout elongated and interwoven rootstocks, erect, stout (3–4 mm. wide towards the base), 3–7 dm. high, aphyllopodic, strongly purplish-tinged and somewhat fibrillose at base, not strongly stoloniferous, exceeding the leaves, smooth or more or less roughened on the angles above. Leaves (not bracts) with well-developed blades usually three to five to a fertile culm, near the base but usually not bunched, the sheaths overlapping, loose, glabrate, white- or yellowish-scarious opposite the blades, the ligule often strongly prolonged, the blades flat, 3.5–5 mm. wide, usually 1–2 dm. long, very rough towards apex, the lower much smaller than the upper; terminal spike staminate, strongly rough-peduncled, linear, 2–3 cm. long, 4–5 mm. wide, the numerous closely appressed scales oblong-obovate, obtuse, purplish brown with light midrib and hyaline margins; pistillate spikes one to three, widely separate or uppermost occasionally approximate, erect, on slender usually much exserted peduncles, the spikes linear or linear-oblong, 1.5–3.5 cm. long, 4–8 mm. wide, loosely or somewhat closely flowered above, attenuate at base, the perigynia 6–20, ascending; bracts leaflet-like, shorter than the culm, the sheaths 5–30 mm. long; scales ovate, varying from obtuse to cuspidate, as wide as but rather shorter than the mature perigynia, straw-colored or purplish brown with green midrib and hyaline margins; perigynia obovoid, obtusely triangular, 2.5–3.5 mm. long, 1.5–2.25 mm. wide, many-nerved, tapering to a stipitate or substipitate base, abruptly rounded at apex and minutely beaked with abruptly bent beak or beakless, the orifice entire; achenes triangular with convex sides, broadly obovoid, 2.5 mm. long, closely fitting the perigynia; stigmas three.

The following specimens have been examined:

NORTH CAROLINA: Satula Mt. (near Highlands), Biltmore *no. 2686*, May 25, 1897 (type in herb. N. Y. Bot. Gard.); Macon County, *Buckley* (Columbia Univ.); Chimney Rock Mt., Rutherford County, Biltmore *no. 268e*, May 10, 1898 (N. Y. Bot. Gard.); Craggy Mt., Buncombe County, Biltmore *no. 268a*, May 18, 1898 (N. Y. Bot. Gard.).

The species discussed under this heading may be distinguished from one another by the following key:

Culms phyllopodic, not strongly purplish-tinged at base, spreading by deep-seated slender white rootstocks.
  Blades of fertile culm 2–3.5 mm. wide; perigynia 2–3 mm. long; spikes linear; plant slender. *C. tetanica.*
  Blades of fertile culm 3–7 mm. wide; perigynia longer; spikes oblong or linear-oblong; plant stoutish. *C. Meadii.*
Culms aphyllopodic, strongly purplish-tinged at base, loosely stoloniferous or with interwoven stout rootstocks.
  Loosely stoloniferous; culms slender; larger blades 4 mm. wide. *C. colorata.*
  Not loosely stoloniferous, but with interwoven stout rootstocks; culms stout; larger blades 5 mm. wide. *C. biltmoreana.*

CAREX RIPARIA AND ITS NORTH AMERICAN ALLIES

The common sedge which has of late years been treated in our text-books as specifically identical with *Carex riparia* Curtis of Europe was by many of our earlier writers treated as a distinct species under the name of *Carex lacustris* Willd. In the treatment of the genus *Carex* in the Pflanzenreich, Herr Kükenthal has adopted a middle course and made our plant a variety of the European plant. He has, however, clearly pointed out the marked differences which exist between the two. These differences hold good in a large series of American specimens and a considerable series of European specimens examined by me. The plants, too, do not have a circumboreal distribution, and, as is well known, there are very few American species of *Carex* not having a circumboreal distribution which are specifically identical with European species. There being these marked differences between the European and American plants and their ranges being so different I cannot understand how one can logically be treated as a variety of the other. It seems to me that the only proper way to do is to recognize the plants as distinct species, and this is what I shall do.

Briefly stated, the European *Carex riparia* is a plant with closely bunched and very thick staminate spikes, the pistillate scales are large and very conspicuously purplish-margined, the fertile culms are phyllopodic, and the lower sheaths are neither fibrillose nor strongly purplish-tinged. On the other hand, the American *Carex lacustris* has scattered slender staminate spikes, the pistillate scales are smaller and the purplish margins generally noticeably less conspicuous, the fertile culms are aphyllopodic, and the lower sheaths are strongly fibrillose and strongly purplish-tinged.

Carex lacustris, as above defined, has a range from Maine and Vermont to Delaware, Minnesota, and Iowa. In the South and West, however, its place is taken by an allied but distinct plant of wide distribution. Although this last-mentioned plant has not in general been differentiated from *Carex lacustris*, yet many years ago it was published by S. Hart Wright as a variety of *Carex riparia* under the name *Carex riparia* var. *impressa* (Bull. Torrey Club 9: 151. 1882). It has the scattered slender staminate spikes of *Carex lacustris* and its pistillate scales are even lighter-colored and with less of a purplish tinge. On the other hand it has the phyllopodic fertile culms not tinged with purplish or but little so and not fibrillose at the base, which are characters of the European *Carex riparia*. From both these species it differs also in the perigynia, which are impressed-nerved when young, but at maturity appear nerveless at a distance or on close inspection very finely impressed-nerved, in contradistinction to the strongly nerved perigynia of the other species above discussed. This plant doubtless deserves specific rank, as the following detailed description will show:

Carex impressa (S. H. Wright) Mackenzie, comb. nov.

Carex riparia impressa S. H. Wright, Bull. Torrey Club 9: 151. 1882.

Culms stout, in dense clumps, 5–8 dm. high, phyllopodic, neither fibrillose nor purplish-tinged at base, stoloniferous, exceeded by the leaves, smooth or more or less roughened on the angles above. Leaves with well-developed blades usually six to twelve to a fertile culm, mostly bunched towards the base, the blades 4–7 mm. wide, sometimes as much as 4 dm. long, flattened or folded at base, nodulose, stiff, varying from smooth on both

surfaces and on the margins (towards the base) to strongly roughened on both surfaces and to almost denticulate on the margins (towards the apex), more or less glaucous, the sheaths glabrous; terminal 2–4 spikes staminate, erect, scattered, 1–4 cm. long, 3–7 mm. wide, the upper peduncled, the others sessile or nearly so, the numerous closely appressed scales oblong-obovate, acute to aristate, from straw-colored to purplish, with hyaline margins and usually lighter midrib; pistillate spikes two to four, usually widely separated, erect, short-peduncled, stout, densely flowered, oblong-cylindric, 1–7.5 cm. long, 1 cm. wide, the very numerous perigynia closely appressed, ascending, in several–many ranks; bracts leaf-like, exceeding the culms, the lower sheaths from little to strongly developed; scales ovate, the lower aristate and often exceeding the perigynia, the others gradually shorter until those in the upper part are acute and but half the length of the perigynia, straw-colored to purplish with hyaline margins and lighter center, very variable; perigynia lanceolate-ovoid, flattened but thick, 6 mm. long, 2.5 mm. wide, impressed-nerved but appearing nearly nerveless at maturity, glabrous, the walls thick and leathery, rounded at base, tapering to the short bidentate beak, the teeth erect or slightly spreading, 0.5 mm. long; achenes triangular-obovoid, 2 mm. long, 1.25 mm. wide, not filling perigynia, tipped by the persistent slightly flexuous style; stigmas three.

The following specimens have been seen:

OHIO: Green Spring, *Beardslee*, June, 1890.

INDIANA: Wells County, *Deam;* Bluffton, *Deam*, May 28, 1899.

TENNESSEE: Jackson, *S. M. Bain 488*, May 10, 1893.

MISSOURI: Courtney, Jackson County, *Bush 702*, May 23, 1894; Jackson Co., *Mackenzie 822*, April 27, 1895; Butler County, *Bush 2554* and *2660*, May 1, 1905.

KANSAS: Quindaro, *Mackenzie*, May 30, 1897; Argentine, *Mackenzie*, April 26, 1896.

INDIAN TERRITORY: Catoosa, *Bush 1028*, May 14, 1895; Sapulpa, *Bush 957*, May 9, 1895; Arkansas, *Bush 985*, May 8, 1895.

ARKANSAS: Moark, *Bush 2609*, May 3, 1905; Miller Co., *Bush 1394*, April 21, 1902; Craighead Co., *Eggert*, May 7, 1893.

TEXAS: Grand Saline, *Reverchon 2441*, April 9, 1901; Dallas, *Reverchon 3311**, April, May; Alvin, *S. M. Tracy 9008*, April 11, 1906.

LOUISIANA: Alexandria, *Hale.*

ALABAMA: Mobile, *C. F. Baker 1555*, April 26, 1898.

GEORGIA: Riceboro, Liberty Co., *Harper 2183*, May 2, 1904.

FLORIDA: Apalachicola, *Chapman, Biltmore no. 225a*; *Chapman*, 1850.

The three species here described may be separated by the following key:

Fertile culms aphyllopodic, strongly fibrillose and purplish-tinged at base. *C. lacustris.*
Fertile culms phyllopodic, neither fibrillose nor strongly purplish tinged at base; perigynia nerved.
  Staminate spikes slender, scattered; perigynia finely impressed-nerved or appearing nearly nerveless at maturity; pistillate scales not prominently purplish-margined. *C. impressa.*
  Staminate spikes thick, closely approximate; perigynia strongly nerved at maturity; pistillate scales prominently purplish-margined. *C. riparia.*

NEW EASTERN SPECIES OF CAREX

Carex aestivaliformis sp. nov.

Carex gracillima × aestivalis Bailey, Bull. Torrey Club **20**: 417. 1893.

Culms densely cespitose, slender, erect or ascending, 3.5–7 dm. high, glabrous or nearly so, sharply triangular and roughened on the angles above, exceeding the leaves, strongly purplish-tinged at base, aphyllopodic. Well-developed blades some four or five to a fertile culm, the sheaths (especially the lower) sparsely short-pubescent, the upper not overlapping; blades glabrous or sparsely pubescent and ciliate near base, rough, 2–3.5 mm. wide, the longer about 3 dm. long, flat, ascending; spikes three or four, widely separate or slightly approximate, narrowly linear, 1.5–6 cm. long, 3.5 mm. wide, the terminal gynaecandrous, the lateral pistillate, nodding or weakly erect on long, slender, rough peduncles, the perigynia 20–40, appressed-ascending, closely packed in few ranks or loosely at base; lowest bract leaflet-like, short-sheathing, shorter or longer than inflorescence, the upper reduced; scales ovate, short-acuminate, acute or obtuse, several-nerved, green with hyaline margins, sometimes tinged with reddish brown, narrower than and about two thirds the length of the perigynia; perigynia oblong-ovoid, flattened-triangular in cross-section, deep green, glabrous, strongly several-nerved, 3–3.5 mm. long, 1.5 mm. wide, sessile and rounded at base, abruptly very short beaked, the beak 0.25 mm. long, minutely bidentate and hyaline-tipped; achenes triangular-obovoid, 2 mm. long, 0.75 mm. wide, not filling perigynia; style straight, slender; stigmas three.

The species above described has to my knowledge been collected in six localities, and each time the collector has had trouble

with it. The first collection was in an upland swale near Alcove, New York, on July 5, 1892, by C. L. Shear, and it was later found by him in two other localities in Greene County, New York. His collections were first doubtfully referred to *Carex Sullivantii* Boott, and later on were described by Professor Bailey (Bull. Torrey Club **20**: 419. 1893) as a hybrid between *Carex gracillima* and *Carex aestivalis*. He, however, pointed out that there were two objections to so classifying the plant, the first being that it had characters possessed by neither of its supposed parents, and the second that *Carex aestivalis* was not known from the country where the present plant was found. Specimens now at hand from the other stations emphasize these two points, and show that the plant cannot be properly treated as it was by Professor Bailey.

The next collection was by me in a mountain meadow near Greenwood Lake, Passaic County, New Jersey, on June 23, 1907 (*no. 2676*). The plant was not common, but as I collected enough to make several specimens, I designate a specimen from this collection as the type of the species.

The plant has lately again been found in eastern Pennsylvania by Mr. S. S. Van Pelt (Wissahickon ravine, Philadelphia Co., east side, above Thorp's Lane, high up, July 17, 1909). Through him it was sent to the New York Botanical Garden with a request that he be informed whether it was *Carex aestivalis* or not.

As a matter of fact the plant is closest to *Carex aestivalis*, but is distinguished by the larger perigynium, which has a bidentate beak, that of *C. aestivalis* not being bidentate. From *Carex Sullivantii*, supposed to be a hybrid between *Carex pubescens* and *C. gracillima*, it is distinguished by the gynaecandrous terminal spike, merely acute or short-acuminate scales, and somewhat narrower and less pubescent leaves. I do not know any hybrid it can represent, and, as it is certainly distinct enough, I here propose it as a species.

The southern *Carex oxylepis*, which is closely allied, has wider and generally more pubescent leaves and strongly acuminate or cuspidate scales.

Carex fulvescens sp. nov.

Culms loosely cespitose from slender rather short rootstocks, erect, 2.5–4 dm. high, rather sharply triangular, smooth or slightly

roughened on the angles above, exceeding the leaves, phyllopodic, and slightly fibrillose at base. Well-developed blades about six to ten to a fertile culm, flat or somewhat folded at base, 2–3 mm. wide, 1.5 dm. long or less, erect or ascending, roughened towards the apex, the sheaths of the upper and of the bracts prolonged at the mouth and strongly tinged with chestnut-brown; staminate spike solitary, slender-peduncled, 1.5–2.5 cm. long, 2–3 mm. wide, the oblong-obovate scales closely appressed, obtuse or subacute, chestnut with white-hyaline margins and apex; pistillate spikes one or two, widely separate, erect, the upper on scarcely exserted peduncle, the lower on a strongly exserted peduncle, short-oblong or oblong, 12–20 mm. long, 7.5–10 mm. wide, closely flowered, the perigynia 15–35, spreading-ascending in several ranks; bracts strongly sheathing, the blades erect, much shorter than inflorescence; scales ovate, short, acute or obtuse, brownish chestnut with conspicuous white-hyaline apex and margins above, the center lighter-tinged, nearly as wide and nearly as long as body of perigynia; perigynia yellowish-green, narrowly elliptic, slightly inflated and suborbicular or obscurely triangular in cross-section, 5–6 mm. long, 1.5–2 mm. wide, strongly and rather closely about 10-nerved, rounded to a substipitate base, and contracted into a rough strongly bidentate beak 1.5 mm. long, the erect slender teeth smooth within; achenes triangular, oblong-obovoid, 2 mm. long, 1 mm. wide, long-tapering at base; style slender; stigmas three.

Many years ago B. D. Greene collected near Boston two species of *Carex*, which are now in the Torrey Herbarium. One of these was described by Dewey in 1836 as *Carex Greeniana* (Am. Journ. Sci. **30**: 61). This name has by most subsequent authors been treated as a synonym of *Carex Hornschuchiana* Hoppe ("*Carex fulva* Good." of most authors). An examination of both the original specimen and the original description of Dewey shows that this course is erroneous. The specimen marked *Carex Greeniana* is a specimen of the European *Carex helodes* Link (*Carex laevigata* Smith) and has the long-acuminate or aristate scales of that species, in this agreeing with Dewey's description, which calls for a plant with cuspidate or mucronate scales.

The other specimen, which is marked "*Carex fulva* Good." is closely related to the European *C. Hornschuchiana* Hoppe and furnishes one of the chief reasons for attributing that species to North America, as has been done for years under the name of "*Carex fulva* Good." What *Carex fulva* Good. really is, has,

however, long been a favorite theme for discussion among European students of *Carex* (Pryor in Jour. Bot. **14**: 366; Kükenthal in Allgem. Bot. Zeits. **11**: 45), and while the older authors generally treat it and *Carex Hornschuchiana* as the same, later authors regard *C. fulva* as representiug something else and have taken up the name *Carex Hornschuchiana* for what was formerly called *C. fulva.*

While closely resembling this European species, the Boston plant differs in the longer perigynia (5–6 mm. long), as compared to perigynia of about 3 mm. in length in the European species. (Kükenthal, Pflanzenreich $\mathbf{4}^{20}$: 665, and numerous specimens examined by me.) In addition, the usually more obtuse scales are very noticeably more white-hyaline at the apex, the spikes are wider and heavier, and the sheath is generally more strongly prolonged opposite the blade and more strongly tinged with dark chestnut.

Besides the specimen collected near Boston (possibly introduced through wild fowls from further north), I have seen specimens from Anticosti (Ellis Bay, *John Macoun 50*, Sept. 7, 1883) and Miquelon (Valley of La Belle-Rivière, *Louis Arsene 93*, July 28, 1902). It is probable, too, that the reports of the occurrence of *Carex fulva* in Newfoundland arise from finding this species there.

Carex Bushii sp. nov.

Carex hirsuta, var. *cuspidata* Dewey, Wood's Class Book 758. 1863.

Carex triceps, var. *longicuspis* Kükenthal, Pflanzenreich $\mathbf{4}^{20}$: 431. 1909.

Culms erect, 3–6 dm. high, growing in medium-sized clumps, glabrate or somewhat pubescent, triangular, shorter than or exceeding the leaves, somewhat purplish-tinged at base. Well-developed blades three or four to a fertile culm, the sheaths short-pubescent, the upper not overlapping, blades short-pubescent (especially below), 1.5–3 mm. wide, the larger 2.5 dm. long, flat, erect-ascending, the uppermost leaf usually inserted shortly below and exceeding the spikes; spikes usually two or three, approximate, oblong or oblong-cylindric, 5–20 mm. long, 5–8 mm. wide (without the scales), the lower half of the uppermost staminate, the remainder pistillate, all erect, sessile or nearly so, densely many-flowered; bract of lowest spike slender, setaceous, some-

what to much exceeding the head; second bract when present much smaller; scales of pistillate flowers triangular-lanceolate, the middle and lower strongly rough-cuspidate, narrower than but exceeding the perigynia (usually strongly so), with green, about 3-nerved center and hyaline often brownish-tinged margins; perigynia obpyramidiform, nearly orbicular in cross-section, swollen and squarrose at maturity, tapering at base, somewhat tapering at the blunt or slightly pointed apex, glabrous, green or becoming brownish at maturity, rather strongly and coarsely ribbed, 2.5–3 mm. long, 1.5–2 mm. wide, the orifice entire or minutely emarginate; achenes strongly triangular, obovoid, large, sometimes 2.5 mm. long and 1.8 mm. wide; style persistent, bent; stigmas three.

The above species is based primarily on Mr. B. F. Bush's *no. 2514*, collected April 30, 1905, at Fulton, Arkansas, and preserved in my own herbarium, but it seems common enough, and from the descriptions there can be no doubt that the synonyms quoted above belong here. I first became acquainted with this plant in 1896 when botanizing on the prairie at Waldo Park, immediately south of Kansas City, Missouri, in company with Mr. Bush, and since then have gradually been accumulating a series of specimens. I am glad indeed to be able to associate Mr. Bush's name with the present plant, and as he seems to have collected more material of it than any other botanist it seems peculiarly appropriate to do so.

Study in recent years has shown that *Carex hirsuta* Willd. of the earlier botanists is undoubtedly an aggregate, and all modern students of the group have treated it either as containing more than one species, or as one species with several strongly marked varieties. The former course seems to me much the more scientific and is accordingly adopted here. The division here made of the old *Carex hirsuta* has been primarily based on the shape of the perigynium. In the plant of Willdenow this is much flattened, ascending, rounded at apex, and more nerved than ribbed. In the other group it is inflated, squarrose, suborbicular in cross-section, pointed at the apex, and strongly ribbed at least towards the apex. The first group is represented by *Carex hirsuta* Willd. and *Carex triceps* Michx., the former differing from the latter only in the more developed pubescence of the leaves, a character which a large series of specimens shows is of no value.

The second group is represented by *Carex caroliniana* Schwein. as well as by *Carex Bushii* here described. The large green

perigynia and strongly rough-cuspidate scales of the latter contrast strongly with the smaller brownish green perigynia and short scales of the former. For convenience these species may be keyed as follows:

Perigynia much flattened, ascending, rounded at apex, nerved. *C. hirsuta.*
Perigynia swollen, nearly orbicular in cross-section, squarrose, tapering at apex, coarsely ribbed.
  Perigynia 2 mm. long, brownish green; scales not rough-cuspidate. *C. caroliniana.*
  Perigynia longer, green; scales rough-cuspidate. *C. Bushii.*

Carex Bushii ranges from Rhode Island (*fide* Kükenthal) and New York to Kansas and Texas and eastward along the coast to northwestern Florida. I have seen the following specimens:

RHODE ISLAND: *Olney* (mixed).*

NEW YORK: Oneida Co., *Haberer 1125*, June 20, 1902; Washington County, *Burnham 48*, July 8, 1898 ("Grows with the species, but at once recognized as different"); Penn Yan, *Sartwell.*

PENNSYLVANIA: Lancaster County, *Carter*, June, 1893 ("very large; var.") and July 11, 1909; Nockamixon Rocks, Bucks County, *Britton*, May 30, 1893; West Chester, *Townsend;* Rockhill, Bucks County, *MacElwee 382*, June 2, 1899.

ILLINOIS: "Illinois" *Vasey*—"*Carex triceps* v. *cuspidata* Dewey"; Jefferson County, *Eggert*, May 16, 1898.

MISSOURI: St. Louis, *Riehl*, 1838; Montier, *Bush 691*, May 15, 1894; *2800*, May 11, 1905; *2896*, May 17, 1905; and *4670*, May 24, 1907; Desoto, *Hasse*, May 24 1887; Courtney, *Bush 1719*, May 26, 1902; Waldo Park, Jackson Co., *Mackenzie*, June 10, 1896.

ARKANSAS: Little Rock, *Hasse*, May, 1885; Fulton, *Bush 2514*, April 30, 1905 (type, in herb. K. K. Mackenzie).

INDIAN TERRITORY: Sapulpa, *Bush 1047*, May 2, 1895.

KANSAS: Cherokee County, *Hitchcock 871*, 1896.

TEXAS: Lindale, *Bush 2449*, April 23, 1901; Alvin, *Tracy 9009*, April 11, 1906; Raleigh, *Reverchon 3619*, April 16, 1903; Galveston, *Plank*, April 10, 1892.

LOUISIANA: New Orleans, *Hooker*, 1827.

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* The Olney distribution of *Carex* seems unfortunately to have become mixed, and it is not safe to rely on the specimens distributed by him in determining the range of any species.

MISSISSIPPI: Starkville, *Tracy 1375*, April 14, 1890.
FLORIDA: Walton County, *Curtiss*, 1885.

NOTES ON NOMENCLATURE

In applying the rules of nomenclature of the "American Code" to the species of *Carex* found in North America, it has been found that a considerable number of species have been known by names which are not tenable. For some of these species valid names exist but to others new names must be given, and for various reasons certain other necessary changes in names must also be made, as follows:

Carex hirtifolia nom. nov.

Carex pubescens Muhl.; Willd. Sp. Pl. **4**: 281. 1805. Not *C. pubescens* Poir. Voy. en Barb. **2**: 254. 1789. Not *C. pubescens* Gilib. Exerc. Phyt. **2**: 547. 1792.

Carex camporum nom. nov.

Carex marcida Boott; Hook. Fl. Bor.-Am. **2**: 212. *pl. 213.* 1840. Not *C. marcida* J. F. Gmel. 1791.

Carex normalis nom. nov.

Carex mirabilis Dewey, Am. Journ. Sci. **30**: 63. *pl. Bb. f. 92.* 1836. Not *C. mirabilis* Host. 1809.

Carex glacialis nom. nov.

Carex pedata Wahl. Fl. Lapp. 239. *pl. 14.* 1812. Not *C. pedata* L. 1763.

Carex Farwellii (Britton) Mackenzie, comb. nov.

Carex deflexa Farwellii Britton; Britton & Br. Ill. Fl. **1**: 334. 1896.

Carex abscondita nom. nov.

Carex ptychocarpa Steud. Synops. Cyper. 234. 1855. Not *C. ptychocarpa* Link. 1799.

Carex debiliformis nom. nov.

Carex cinnamomea Olney, Proc. Am. Acad. **7**: 396. 1868. Not *C. cinnamomea* Boott. 1846.

CAREX LASIOCARPA Ehrh. Hann. Mag. 9: 132. 1784.

"*Carex filiformis* L." Good. Trans. Linn. Soc. 2: 172, and of all American authors; not *Carex filiformis* L.

European writers have determined that the name *Carex filiformis* L. is not applicable to the plant which has so generally borne the name, but is properly applicable to *Carex tomentosa* L. Accordingly they now apply the name *Carex lasiocarpa* Ehrh. to the plant heretofore known as *Carex filiformis* L.—a course which is here followed. The description and locality of the plant of Linnaeus do not apply to the plant treated by authors as *Carex filiformis*, although there is a specimen of this plant in the Linnæan herbarium so named. See on this point Kükenthal, Pflanzenreich 4^{20}: 748.

CAREX LEERSII Willd. Prodr. Fl. Berol. 28. 1787

Carex stellulata Good. Trans. Linn. Soc. 2: 144. 1794.
Carex sterilis Willd. Sp. Pl. 4: 208 (in greater part). 1805.

CAREX SPRENGELII Dew.; Spreng. Syst. 3: 827. 1826

Carex longirostris Torr.; Schwein. Ann. Lyc. N. Y. 1: 71. 1824. Not *C. longirostris* Krock. 1814.

CAREX BARRATTII Schw. & Torr. Ann. Lyc. N. Y. 1: 361. 1825

Carex littoralis Schwein. Ann. Lyc. N. Y. 1: 70. 1824. Not *C. littoralis* Krock. 1814.

Carex Howei nom. nov.

Carex interior, var. *capillacea* Bailey, Bull. Torrey Club 20: 426. 1893.
Carex delicatula Bicknell, Bull. Torrey Club 35: 495. 3 N 1908. Not *C. delicatula* C. B. Clarke, Kew Bull. Misc. Inf. Add. Ser. 8: 79. 18 Au 1908.

Named in honor of the late Dr. E. C. Howe, a careful student of the difficult group to which this species belongs.

CAREX ATHERODES Spreng. Syst. 3: 828. 1826

Carex aristata R. Br. in Frankl. Narr. Journ. Bot. App. 36. 1823. Not *C. aristata* Honck. 1792. Not *C. aristata* Clairv. 1811.

Carex rhomalea (Fernald) Mackenzie, comb. nov.

Carex saxatilis, var. *rhomalea* Fernald, Rhodora **3**: 50. 1901.

CAREX LACHENALII Schk. Riedgr. 51. *pl. y. f. 79*. 1801.

Carex lagopina Wahl. Kongl. Vet.-Acad. Handl. **24**: 145. 1803.

Carex mesochorea nom. nov.

Carex mediterranea Mackenzie, Bull. Torrey Club **33**: 441. 1906. Not *C. mediterranea* C. B. Clarke. 1896.

Carex aggregata nom. nov.

Carex agglomerata Mackenzie, Bull. Torrey Club **33**: 442. 1906. Not *C. agglomerata* C. B. Clarke. 1903.

Carex amphigena (Fernald) Mackenzie, comb. nov.

Carex glareosa, var. *amphigena* Fernald, Rhodora **8**: 47. 1906.

CAREX ANNECTENS Bicknell, Bull. Torrey Club **35**: 492. 1908.

Carex xanthocarpa Bicknell, Bull. Torrey Club **23**: 22. 1896. Not *C. xanthocarpa* Degl. 1807.

Carex xanthocarpa annectens Bicknell, Bull. Torrey Club **23**: 22. 1896.

Carex Swanii (Fernald) Mackenzie, comb. nov.

Carex virescens, var. *minima* Barratt; Bailey, Mem. Torrey Club **1**: 77. 1889. Not *Carex minima* Boullu. 1878).

Carex virescens, var. *Swanii* Fernald, Rhodora **8**: 183. 1906.

"*Carex virescens* Muhl." Britton & Br. Ill. Fl. **1**: 316. *f. 743*. 1896, and of other recent writers.

Common in the northeastern part of the United States are two closely related sedges, one or the other of which has been treated as *Carex virescens* Muhl. by authors who have had occasion to deal with them. Unfortunately, there has been considerable diversity of opinion as to which plant should bear the name, and the facts on which the question must be decided seem somewhat contradictory. So much is this so that Professor Fernald (Rhodora **8**: 182, 183) and Mr. Bicknell (Bull. Torrey Club **35**: 488, 489) have reached opposite conclusions.

Before taking up the literature on the subject, it is necessary to obtain a clear idea of the two species, and this is all the more requisite because there are certain distinctions between them, not always emphasized, which help materially to clear up the difficulty.

The first of the species referred to is a tall slender plant strongly reddened at base, generally 4–7 dm. high with the culms much exceeding the leaves. The uppermost stem leaf is usually inserted 2–3 dm. below the spikes, but occasionally at a less distance. The lowest bract is leaflet-like, 0.5–2 mm. wide, and somewhat exceeding the spikes. The spikes themselves are two to four in number, linear-cylindric, 12–35 mm. long, and 2.5–4 mm. wide. The perigynia are oblong-elliptic, round-tapering at apex, and generally strongly costate. This last character is, however, variable and the ribs at times are even less prominent than in the other plant. The perigynia too, especially towards the base of the terminal spike, are apt to become broadly obovoid and rounded at apex.

The second plant is also slender but much lower (2–5 dm. high). The reddening at base is rarely much developed, and the culms are exceeded by the leaves. The uppermost stem-leaf is usually inserted 3 cm. below the spikes, but occasionally as much as 12 cm. The lowest bract is very narrow (0.5 mm. wide) and about twice exceeds the uppermost spike. The spikes are oblong-cylindric, 5–20 mm. long and 3–5 mm. wide. The perigynia are broadly obovoid, rounded at apex and from little to markedly costate.

These two plants are perfectly distinct and I have been able to discover little warrant for the statement that there are "numerous transitional specimens." Undeveloped specimens are at times hard to place but this is true in all groups of critical species.

Following Professor Bailey, the second plant above described has of late years been treated as *Carex virescens*. His treatment was based on the fact that in studying the types of *Carex* in European herbaria he had occasion to look up the plant under discussion in the Willdenow herbarium. He says of the specimen found there: "a slender and short-spiked form. *C. triceps* var. *hirsuta* Bailey is also on the same sheet, but the description applies to *C. virescens*" (Mem. Torrey Club **1**: 60, also 76, 77, and 78). In

other words, there has evidently been some confusion of specimens in this case as in others, and one is not justified in accepting the sheet in the Willdenow herbarium as containing the type of *Carex virescens* unless the specimen there accords with the description.

Turning to the description it will certainly be admitted that a short-spiked form does not answer to a description which calls as in the present case for a linear spike, and, this being so, our only safe course is to study the original description and ignore the plant in the Willdenow herbarium.

Like a number of other Carices described by Muhlenberg, *Carex virescens* was published first in Willdenow's Species Plantarum (4: 251) in 1805, and secondly in Schkuhr's Riedgraser Nachtr. (45) in 1806. The descriptions are practically identical, but the second is accompanied by a plate (*Mmm. f. 147*). The description reads:

"C. spica androgyna lineari pedunculata inferne mascula, femineis subapproximatis binis subpedunculatis linearibus, fructibus globoso-triquetris obtusis pubescentibus. . . . Capsula[e] maturae virides subnervosae pubescentes."

The plate shows a young plant with the uppermost stem-leaf inserted much below the spikes and a broad (comparatively) lower bract somewhat exceeding the spikes. A more mature specimen is also shown with the same kind of lower bract and *strongly costate* perigynia round-tapering at apex. The spikes in both cases are shown to be linear-cylindric. Both these figures seem to me to represent the larger of the two plants under discussion. There are also figured separately obovoid perigynia without ribs on one-half but ribbed on the other half. The draftsman apparently here attempted to give a side view so as to show the nerveless inner surface of the perigynia and the nerved outer surface at the same time. The result is an uncharacteristic drawing, but there is nothing about it inconsistent with the same reference as the rest of the plate.

The plate and the description calling for a linear spike both answer then to our larger plant, and I feel justified in following Professor Fernald in so treating it. I do not, however, think that the identity of the smaller plant should be obscured by treating it as a variety. Accordingly, I have here used Professor Fernald's

varietal name as a specific one, the earlier varietal name of Barratt having already been used for a species.

CAREX RECTA Boott, Hook. Fl. Bor.-Am. **2**: 220. *pl. 222.* 1840

Carex salina, var. *kattegatensis* (Fries) Almq. in Hartm. Handb. Scand. Fl. 466. 1879. [ed. 11.]
" *Carex cuspidata* Wahl." Britton & Br. Ill. Fl. **1**: 311. 1896.
" *Carex salina*, var. *cuspidata* Wahl." Gray's Manual 230. 1908. [ed. 7.]

In dealing with the various closely allied plants which by some authors have been treated as species and by others as varieties of *Carex salina* Wahl., the latest author to study the group (Kükenthal, Pflanzenreich 4^{20}: 361–363) has pointed out that the name *Carex cuspidata* Wahl. is not applicable to the plant found on the northeastern coast of this continent. The name to be taken up for this plant is *Carex recta* Boott, or if one prefers a varietal name the pleasant-sounding name given in the synonymy above is open to him.

In this connection it may be pointed out that *Carex lanceata* Dewey (Am. Journ. Sci. **29**: 249), referred by Kükenthal, following Boott, to *Carex salina* as a variety, is probably a mixture of *Carex livida* (Wahl.) Willd. and *Carex salina* Wahl. The original collection in the Torrey herbarium is mixed and contains both species, and the description applies in part to both species, while Dewey compares the species to his *Carex Grayana* (a synonym of *Carex livida*). The plate (a poor one) is of *Carex salina*, but it does not agree with the description.

CAREX ATLANTICA Bailey, Bull. Torrey Club **20**: 425. 1893

In Professor Fernald's very able paper on the Northeastern Carices of the Section Hyparrhenae (Proc. Am. Acad. **38**: 447 *et seq.*) there is very little to which one can take exception, but on the contrary a careful study of the group treated leaves one very largely in accord with the treatment given. However, in identifying *Carex sterilis* Willd. with *C. atlantica* Bailey it seems to the present writer that a mistake was made. The grounds for this view are the following:

(1) Both Willdenow and Schkühr in their descriptions lay particular stress on the dioecious character of the spikes of the plant described by them, and in fact the name is taken from this character. *Carex atlantica* never to my knowledge shows this character, while on the other hand forms of *Carex Leersii* (*Carex stellulata*) do.

(2) *Carex atlantica* is a species of the coastal plain and is very rarely found inland. *Carex sterilis* was collected in Pennsylvania, probably near Lancaster, in a region where forms of *Carex Leersii* are very abundant.

The reason advanced by Professor Fernald for identifying *Carex sterilis* with *Carex atlantica* is chiefly that some of the original material has a broad and short-beaked perigynium as compared with the narrower and long-beaked perigynium of *Carex Leersii.* In this, however, this material agrees also with the recently described *Carex incomperta* Bicknell — a plant which, undoubtedly, is found around Lancaster, Pennsylvania, as it is not confined to the coastal plain.

Schkuhr's figure is based partly on young plants showing the dioecious character from which the name is taken and which should therefore be regarded as the type of the species, and partly on more mature plants showing broad short-beaked perigynia. The former seem to me to answer only to *Carex Leersii*, while the latter seem to me more probably referable to *C. incomperta* than to *C. atlantica.* Under the circumstances I would treat *Carex sterilis*, as a synonym of *Carex Leersii*, and maintain *Carex atlantica* and *C. incomperta* as valid species.

The genus Crataegus, with some theories concerning the origin of its species*

Harry B. Brown

Doubtless the genus *Crataegus* has puzzled systematic botanists more the past decade or two than has any other genus of phanerogamic plants. A number of careful workers have been studying the genus for several years but as yet only tentative conclusions have been reached.

In Gray's Field, Forest, and Garden Botany, published in 1857, there was listed for the states east of the Mississippi River, twelve species and two varieties of *Crataegus*. This included both wild and cultivated species. Ten species and four varieties were listed in the edition of Gray's Manual of Botany published in 1867. This included both wild species and species escaped from cultivation. In Chapman's Flora of the Southern United States, published in 1860, eleven species and one variety were described. These were largely the same as the species described in Gray's Manual, only three being different. In Coulter's Manual of the Botany of the Rocky Mountain Region, published in 1885, four species were described; two of these were included in Gray's Manual. In the Cayuga Flora, published in 1886, there were six species and one variety; this included the species of the Cayuga Lake basin. Focke's estimate in Engler & Prantl, Die Natürlichen Pflanzenfamilien, published in 1888, was that there were thirty to forty species growing in the north temperate zone. In the edition of Gray's Manual issued in 1889, there were only ten species and four varieties described. Chapman's Flora of the Southern United States, published in 1897, gives but fifteen species coming within its range, but about this time something happened to the genus, apparently — species seemed suddenly to become much more abundant. In Britton's Manual, issued in 1901, thirty-one species were described. This covered the northern states and extended westward to about the 100th meridian. In Small's Flora of the Southeastern United

* Contribution from the Department of Botany of Cornell University, No. 139.

States, published in 1903, one hundred and eighty-five species were described — an increase of one hundred and seventy in just six years, for Chapman, covering practically the same region, had fifteen in 1897. Sargent's Trees of North America, issued in 1905, contained descriptions of one hundred and thirty-two species having characters such that they can be called trees. This covered all of North America, north of Mexico.

During the past two years new works appeared — Britton's North American Trees and Gray's New Manual of Botany. The genus *Crataegus* was treated by W. W. Eggleston in both of these works. He favors the reduction of the number of species to the narrowest limits possible. In the work on trees, he lists fifty-one species large enough to be called trees, or tree-like in form; in Gray's New Manual, sixty-five species and about fifty varieties are described.

After devoting a limited amount of time to the study of the forms of the local flora of the Ithaca region, with the help of Mr. Eggleston and Mr. John Dunbar of Rochester, we have identified about thirty species and four or five varieties.

Prior to 1896, about one hundred North American species of *Crataegus* had been described; of these a large percentage are not tenable. Since 1896, eight hundred and sixty-six species and eighteen varieties have been described (most of them since 1900). The proposers of these are as follows:

E. L. Greene,	1 species.	
G. V. Nash,		1 variety.
J. K. Small,	1 species.	
A. A. Heller,	1 species.	
T. Howell,	1 species.	
C. H. Peck,	1 species,	1 variety.
J. H. Schuette,	1 species,	3 varieties.
F. Ramaley,	2 species.	
C. L. Gruber,	3 species,	2 varieties.
A. Nelson,	4 species.	
N. L. Britton,	8 species,	2 varieties.
W. W. Eggleston,	10 species,	3 varieties.
C. D. Beadle,	144 species.	
W. W. Ashe,	165 species.	
C. S. Sargent,	524 species,	6 varieties.

Many parts of the country have not yet been worked over thoroughly, and new descriptions are bound to appear for some time to come.

Species do not seem to be so abundant in western North America or in other parts of the world. Howell's Flora of Northwest America includes but two species; Jepson's Flora of Western Middle California, one; Rydberg's Flora of Colorado, but five; and the Coulter-Nelson New Manual of Botany of the Central Rocky Mountains, nine. There are about twelve species from the Rocky Mountains west, north of Mexico. Grisebach lists none in the Flora of the British West Indian Islands. In Bentham and Hooker's Genera Plantarum, but twelve species are said to be found in Europe, Asia, and Japan. It remains to be seen whether or not many more species will be found in these regions upon closer study.

A consideration of the foregoing facts brings up a number of interesting questions. Why did not the systematists discover the great number of species years ago? We cannot say they did not do careful work. Can it be that the number of species has multiplied greatly within the last few decades? Have the older species been hybridizing so that many of the forms at present are hybrids?

In order to get some light on some of these questions the following list of questions was sent to each of the following men, who are regarded as leading students of the genus in this country: C. S. Sargent, W. W. Eggleston, W. W. Ashe, C. D. Beadle, Ezra Brainerd, and John Dunbar.

1. Why did not the sytematic botanists discover the large number of species of *Crataegus* years ago?

2. Do you consider the species now being described elementary species?

3. Do the species breed true or come true to seed?

4. Will different species hybridize?

5. Do you consider the numerous species to have arisen as mutations?

Professor Sargent, director of the Arnold Arboretum, has perhaps devoted more time to the study of the genus than has any other man and has described many new species. In answer to the questions, he says:

1. Because they did not use their eyes and were satisfied to take for granted that what had been published about the genus was correct and final.

2. I do not know what you mean by elementary species.

3. We have planted in all nearly three thousand numbers of seeds at the Arboretum and so far have found no evidence that the different species do not come true from seed. In fact the seedlings of no other genus that has been raised here have shown such a remarkable resemblance to the parent plants.

4. We have never found here any evidence that the different species hybridize.

5. I cannot answer this question.

W. W. Ashe, of the Forest Service, U. S. Department of Agriculture, has studied East-American species of *Crataegus* considerably. His answers are:

1. The species of *Crataegus* were not recognized earlier because the material was studied entirely in a dry state, in which distinctive characters are very largely lost. It was not uncommon to find in the largest collections specimens of most different forms from widely separated parts of North America bearing the same name. Several groups even were not recognized; for example, *Intricatae*, all species of which were called "*coccinea*."

2. Some of the species now being proposed are undoubtedly elementary. Most of them, however, are certainly not. The 10- and 20-stamened forms with slight accompanying differences in fruit, or differences in anther color with slight accompanying differences in fruit are clearly elementary species. When differences extend to inflorescence, size of flowers, and foliage, the sum of the correlated characters may be regarded as entitling the form to full specific rank.

3. Many of the species are known to breed true through their seed. Most of them have not been sufficiently tested for conclusive proof.

4. Many species hybridize and some of those which have been proposed are undoubtedly hybrids. Hybrids are probably no more numerous, however, than between the nearly related species of American oaks. It is also undoubtedly true that some of the

species and groups based on the number of stamens are not valid, since I am now pretty sure that forms of some species may have either ten or twenty stamens.

5. Some of the species probably originated as mutations. The limit of fluctuating variation is undoubtedly wide in some groups, but there is frequently a correlation of characters in the species which in their stability suggests elementary species rather than more instable variation of mutation. Some of the forms in the *Molles* group, in Missouri and Illinois, would seem to be mutations, leading to the inference that some species of this group have originated in this manner. The variation in the *Pruinosae* in the Appalachians and the localized valley species also indicate mutation origin.

C. D. Beadle, director of the Biltmore Herbarium, at Biltmore, N. C., has made an extended study of southern forms of *Crataegus*. His answers are as follows:

1. It is necessary to know the complete history of the *Crataegus* species before an understanding of its status is possible. A parallel is well typified in the study of *Viola*, where a knowledge of the complete vegetative phases of each species must be understood in order to differentiate them. The earlier systematic botanists worked largely in the herbarium. The opportunity of dissolving the mysteries of the *Crataegus* genus may be gained only in the field and by studying groups of marked trees.

2. Yes and no. There is a large number of *Crataegus* species undoubtedly; and, no doubt, there is much duplicating in the specific publications by the different authors who are working altogether too independently of each other's discoveries.

3. Yes, I proved that they come true to seed before daring to publish a new species in this field.

4. Very probably they hybridize.

5. Yes, they are mutations.

W. W. Eggleston, of the New York Botanical Garden, is another distinguished student of the genus. He has studied the specimens in all of the larger herbaria of the country, the living plants in the different arboreta, and for a decade or more he has been making an extended study of plants in the field in various

parts of the country, especially in the eastern half of the United States. He, as was stated above, believes in reducing the number of species; he does this by making certain species of different authors equivalent, and by reducing other species to the rank of varieties. His discussion in regard to the questions is as follows:

Systematic botanists did not know the species in America largely because they never saw them. The Gray Herbarium and the Torrey Herbarium were both very scanty in *Crataegus*. The manuals took most of the forms they had. The coastal plain has very few *Crataegi*, and that is where a large share of the early collecting was done. The European botanical gardens had many more American species than were known here, and it is through them that the work commenced.

Crataegus plants produce much good seed and the plantations at Biltmore, Arnold Arboretum, and at the New York Botanical Garden, show that the forms of the genus reproduce themselves surprisingly from the seed (leaf characters only; trees mostly not yet fruiting). They doubtless will hybridize, and there are probably mutations, too.

Dr. Ezra Brainerd, ex-president of Middlebury College, Middlebury, Vt., was another authority questioned. He writes:

The queries that you raise in your letter of Nov. 15 regarding *Crataegus* are queries that have been puzzling me for over six years, and I am not even yet prepared to answer them with any positiveness. The problem is part of a larger one that I have been diligently studying as it is presented in the genus *Viola;* and here with very satisfactory results. Experimental work in *Crataegus* is difficult, as in this genus it is about 7 to 10 years from generation to generation: *Viola* affords a new generation each year. So I shall be able to give only brief and inadequate answers to your questions.

1. I fancy the systematic botanists did not "discover the large number of species of *Crataegus* years ago," because (*a*) they had broader conceptions of what constitutes a species than most modern botanists have; many recently made species used to be considered mere forms or varieties; (*b*) the genus *Crataegus*, I believe, has vastly increased in individuals and in "forms" in the northeastern U. S. since the forests were cut off; specimens are rarely found in the original forests of this region. But the plants rapidly take

possession of neglected pastures, fence-rows, and untilled ledges; (*c*) the older botanists had no time for the intensive study of a genus of numerous closely allied forms, such as *Crataegus*.

2. Many or most of "the large number of species now being described," if proper species at all, would have to rank as "elementary species." But some recently made species are, I believe, mere "fluctuations" or "forms."

3. I have never raised seedlings of *Crataegus;* Dr. Sargent has in large quantities, and he insists on it that as respects foliage they breed true to seed.

4. I must confess I have never attempted to hybridize *Crataegus* species; I know of no one who has attempted it with our American species. The few species of Europe cross in many ways (see Focke's Pflanzen-mischlinge, p. 146). I know of several cases of what appear to be natural hybrids, "local species," each quite intermediate between the two supposed parent species with which it is associated. The Rosaceae are of all orders most predisposed to hybridize. *Rosa*, *Rubus*, *Geum*, *Amelanchier*, and *Malus* are notorious for the forms resulting from interbreeding. By analogy we should expect the same condition of things in *Crataegus*. The array of closely allied forms (hardly distinguishable even by an expert) present a condition of things in *Crataegus* that is perfectly paralleled in *Rubus*, *Rosa*, and *Viola*. The multiplicity of even stable forms that may result (in the working out of Mendel's Laws) from one pair of parents is astonishing. The swarms of "elementary species," I suspect, have in some instances come about in this way.

5. There may be "mutations" in *Crataegus;* but it would be very hard to prove.

John Dunbar, of the Park Department, Rochester, N. Y., is another enthusiastic student of the genus. In answering the questions, he says:

1. No doubt they (the early systematists) believed honestly, without thorough investigation, that the large number of variations, which, of course, they could not help but detect, were mere forms of several species.

2. They are true species.

3. They do breed true. The progeny come with remarkable fidelity to the specific typical characters of the parents.

4. They may hybridize, but I have seen no evidence of it.

5. I have not given much attention to the conception of mutation in regard to the origin of species. It may be true. In the meantime I am inclined to believe in the Darwinian theory, that natural selection with other agencies, acting on varieties, and extending over a long period, has produced these *Crataegus* species, and all other species. The fact that the thorns are exceedingly hardy, virile, and distributed over a large area, and well fitted to maintain the struggle for existence, no doubt has given them a tendency to much variation, and in the course of many generations these inherited "traits" have become fixed and specific, and hence, new species, after a long lapse of time, appeared.

From studies, observations in the field, and what has been learned from special students of the genus as above set forth, we may arrive at certain tentative conclusions, which at least serve as working hypotheses.

There is no doubt that former systematists conceived of species as being much more composite than they are at present regarded by many. The Linnaean conception prevailed. In older herbaria we often find two quite distinct forms, forms now regarded as different species, mounted on one sheet; this may be taken as evidence of the broader conception of species that formerly prevailed.

Recent workers who have been studying species closely, especially students using the culture method, find that many systematic species are made up of a number of distinct forms, or elementary species that breed true when propagated by seed. A notable illustration of this is *Draba verna*, which has been studied by Jordan. In many of the descriptions of species of *Crataegus* recently offered, lines have been drawn so closely, forms separated by such fine distinctions that we doubtless have descriptions of elementary species. But this can be proved only by long culture experiments.

I am inclined to think that a great many of the *Crataegus* forms we have are hybrids. European species are known to hy-

bridize; species in several other genera of the rose family hybridize freely. During the spring of 1908, I pollinated a few *Crataegus monogyna* (English hawthorn) flowers with pollen from *C. Brainerdi*, a native species. They set fruit which matured. During the flowering season of 1909, Mr. William Moore and the writer made cross pollinations between the majority of the native species of the local flora. Most of these cross pollinations were effective, — fruit set and matured, being entirely normal apparently. (These experiments are still in progress, the details of which will be published later.)

Within the past few decades, since the primitive forests have been cleared away, there has been an immense increase in the number of *Crataegus* plants growing. Being low trees or shrubs they cannot thrive in dense forests but spread freely over open pastures and along fence rows. The pasture southeast of the campus of Cornell University, a field of some twenty or twenty-five acres, has at least a thousand plants. This field has been allowed to run to pasture for the last twenty-five years or more, and *Crataegi* have thriven well. The original forest was cleared away years ago. The increase in number of plants makes cross pollination easier and much more probable. Bees and other insects swarm about the trees when they are in blossom, going from flower to flower and from tree to tree.

Irregularity in the number of stamens and pistils, variation in the shape of the leaves on the plant, variation in the color of the anthers (colors ranging from nearly white to dark purple intergrade), and the occurrence of plants possessing characters found in two distinct species growing near by, may all be taken as evidence of hybridity or progressive species. Numerous local species is another indication. There is scarcely a state that has not some species not found elsewhere; many of the species found in this immediate locality are different from species found at Rochester.

The fact that *Crataegus* plants seem to come true to type when grown from seed is a stumbling block in the way of a hybridity theory. However, it is possible that *Crataegus* hybrids are stable and come true to type when grown from seed. It cannot be said that they have been tested thoroughly until many mature plants have been grown.

Some of the points just made may be taken as evidence of mutations, but the best known mutants are not as irregular in characters as many of the species of *Crataegus.* Cultures carried through several generations are necessary in order to test whether or not *Crataegus* species throw off mutants.

I am greatly indebted to the gentlemen mentioned for their kindness in answering my questions, and to W. W. Eggleston, especially for data concerning the number of species attributable to the different authors.

CORNELL UNIVERSITY,
ITHACA, NEW YORK

Two new seed-plants from the Lake Tahoe region, California

Ernest A. McGregor

Apocynum bicolor sp. nov.

Erect, 4–5 dm. high, wholly glabrous: lateral branches mostly shorter than the main stem and sterile: leaves spreading or somewhat ascending, deep green above, pale glaucous below, ovate-acute, cuspidate, the largest 6 cm. × 3.75 cm., the smaller 3.5 cm. × 2 cm., midvein almost white, prominent; petioles 3–5 mm. long: inflorescence usually a small dense terminal, often cymose panicle, considerably surpassed by the leaves, or occasionally with a similar but smaller panicle in one or two axils below; bractlets of the inflorescence minute, subulate: calyx campanulate, 3 mm. long, segments triangular-lanceolate, acute, with recurved tips, greenish, tinged with purple: flowers pale rose-tinged, cylindrical, 7 mm. long, the lobes finally spreading, narrowed but obtuse; tube 4 mm. long by 2.5 mm. wide: stamens 3.5 mm. long, the stout filaments half as long, densely pubescent, and half covered by the anthers, with a free, lacerate, terminal margin; anthers lanceolate, acute, 2.5 mm. long, the base deeply notched, with rather pointed inturned lobes; appendages between the stamens broadly ovate-turbinate, apiculate: stigma of two sessile oval lobes.

The type is *no. 32*, collected by the author Aug. 19, 1909, in Glen Alpine, near Lake Tahoe, California, growing in a meadow, alt. 2260 m.

This species is rather intermediate between the so-called *androsaemifolium* and *cannabinum* types (as they have been described by Greene, Pittonia 3: 229). The erect habit of the plant and the cylindrical flowers belong to the *cannabinum* division, while the foliage characters and the color of the flowers belong to the other type.

When the Synoptical Flora, vol. 2, part 1, was issued, in 1878, only two species of *Apocynum* were recognized in North America, viz., *A. androsaemifolium* and *A. cannabinum*, and the distinction between them was none too marked. At the present date there are some thirty species recognized in North America, which as a rule are referred to one or the other of two groups based on these two

original species. The result is that a sort of "Apocynal chaos" obtains, such as we find existing in only too many of the so-called "tough groups." A serious treatment of the genus should be

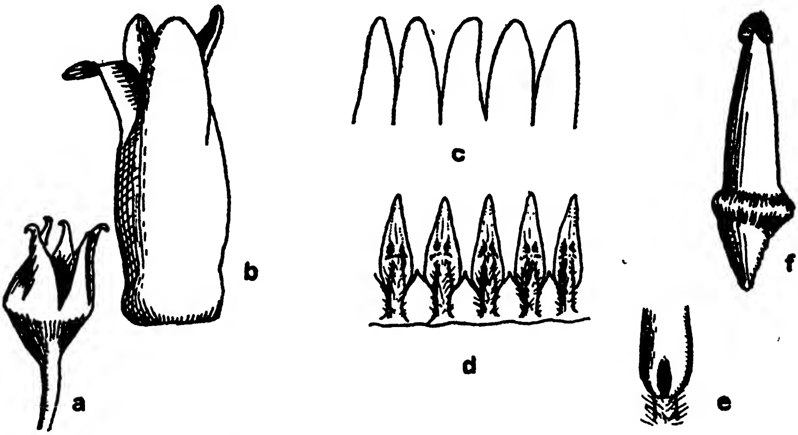

FIGURE 1. *Apocynum bicolor* McGregor; *a*, calyx, × 6; *b*, corolla, × 6; *c*, corolla lobes laid open, × 6; *d*, corolla tube laid open, exposing stamens and appendages, × 6; *e*, anther (outer view) to show basal lobes, × 9; *f*, pistil, showing stigma lobes × 11.

attempted, which I think might result in the reduction of several present-day species. The plant described above cannot be referred to any recognized species, and as its characters are fully as distinctive as those of any of the genus, I have felt justified in proposing it as the type of a new species.

Lappula Jessicae sp. nov.

Erect, simple to near the top, 5–7 dm. high, with short hirsute pubescence throughout, which is mostly spreading on the stems and petioles but appressed on the blades and inflorescence: leaves all entire and all surpassing the internodes, the blade always longer than the petiole; lower leaves oblong-oblanceolate, acutish or obtuse, gradually attenuate to the narrow-margined petioles, the largest 18 cm. long by 2.25 cm. wide; cauline leaves becoming sessile and broadly oblong-lanceolate and reduced above, even those of the inflorescence, however, quite ample and ovate-acuminate: inflorescence usually paniculately disposed but often quite flat-topped; peduncles simple, flowering to near the base, or more often once forked near the top, in which case the flowers are entirely restricted to these branchlets; pedicels at least equaling the calyx and recurved in fruit: calyx split nearly to the base, the

segments linear-oblong, obtuse, reflexed in fruit, about 3 mm. long: corolla sky-blue with whitish tube, the lobes rectangular, obtuse, 3 mm. long, about equaling the tube: corolla-appendages in outline acorn-shaped, broader than high; appendage proper, corresponding to the cup, retuse above and densely short-papillate; protuberance, corresponding to the acorn, rounded below and not projecting inward: anthers attached midway in the tube and just reaching to the appendages, oblong, 1 mm. long, with a broad hyaline irregular wing extending the full length of each angle, the filaments triangular-subulate, concealed by, and less than half as

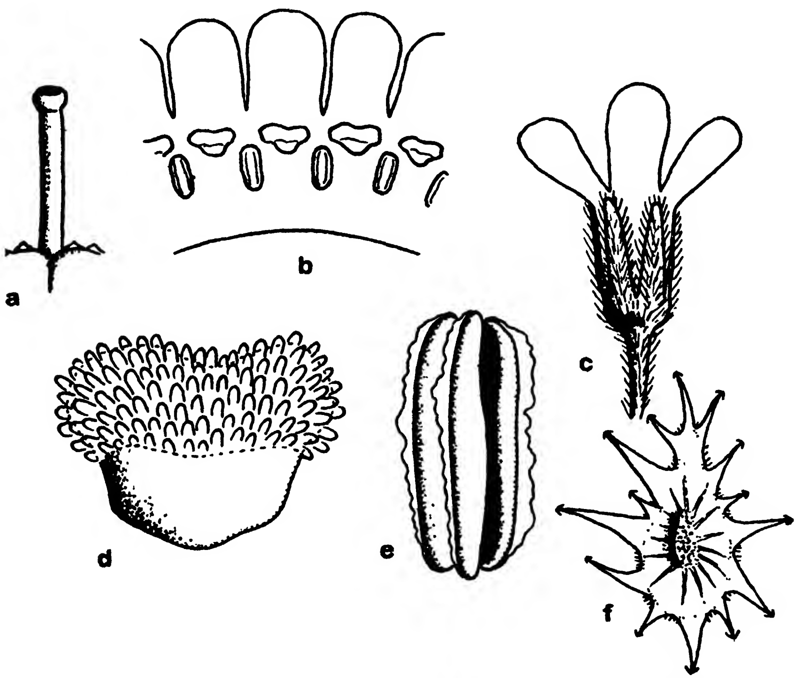

Figure 2. *Lappula Jessicae* McGregor; *a*, style, × 10; *b*, corolla laid open, exposing anthers and appendages, × 6; *c*, single flower, × 5; *d*, corolla appendage, × 35; *e*, anther, showing hyaline wings, × 35; *f*, nutlet (ventral view), × 8.

long as the anthers: style comparatively short and stout; stigma capitate, terminally indented: fruit secund, 5 mm. long; nutlets ovate-acuminate, with about 10 marginal prickles and occasional smaller ones between, the larger prickles triangular-subulate, about 1.5 mm. long, all free to the base; back of nutlets smooth except for minute sharp spines uniformly distributed and exactly resembling the individual barbs of the glochidiate prickles, and for 1 (or 2) glochidiate prickles on the middle of the keel; ventral surface glabrous with elliptical central scar from which run radiating lines.

On wet ground, Half Moon Lake, near Lake Tahoe, California, Aug. 9, 1909, collected by the author, *no. 71.*

Of the *L. floribunda* type, perhaps nearest to *L. micrantha* Eastwood, but differing in the size of the flower, relative sizes of the perianth parts to one another, in relative size of anther to filament, and especially, perhaps, in the conspicuous wings of the anthers, as well as marked differences in the character of the nutlets.

Named in honor of my sister, who has assisted me greatly in the field.

Leland Stanford Junior University.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1910)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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Vol. 37 No 6

BULLETIN

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TORREY BOTANICAL CLUB

JUNE, 1910

The effects of adding salts to the soil on the amount of non-available water*

William T. Bovie

In the experiments described in the following pages an attempt has been made to determine the effect upon the amount of non-available water, when varied amounts of sodium chloride or the salts of a full nutrient solution have been added to the soil. It has been found that with a soil of pure silica, containing about 0.03 per cent. of calcium, aluminum, and iron,† the amount of non-available water is not altered by the addition of either sodium chloride or the salts of a full nutrient solution. In the case of the sodium chloride series, at least, the water was used up by the plants faster than the salts, and as the point of non-available water was approached, the concentration of the soil water must have increased. In many cases the amount of sodium chloride was so great that the saturation point of the salt was passed long before the plant wilted. Adsorption, in some form or other, took place. We are concerned here then, not only with non-available water but also with the adsorption of salts from soil solutions.

Previous work on non-available water

In the late summer of 1859, Sachs[16] determined the retarding influence on transpiration, of various salts and soils. He then determined the amount of water retained by soils when tobacco

*Contributions from the Department of Botany of the University of Missouri no. 18.

†See table of mechanical analysis of soil on page 279.

[The Bulletin for May, 1910 (37 : 215–272. *pl. 25–32*) was issued 2 Je 1910.]

plants wilted in a moist atmosphere. The soils used were a mixture of black beach humus and sand, a loam, and a pure sand (ground quartz). He found different amounts of non-available water in each of the soils; the beach humus having the greatest amount and the sand the least. He pointed out the importance of determining the amount of water available to plants in various soils, and showed that it bears no fixed relation to the amount of water which the dry soil will take up and hold (saturation capacity). He attributed the greater amount of non-available water in the humus soil to the greater adhesion between the water and the soil.

From the time of Sachs' paper, until Bogdanhoff[1] published his paper in 1893, but little attention was given to the subject of non-available water, though soil moisture received the attention of a great many investigators. In his paper, Bogdanhoff pointed out the errors introduced through chemical changes, when hygroscopic water is measured by determining the loss of weight in soils dried in an oven at 100° C. He found percentages of hygroscopic water, as measured by germinating seeds used as an indicator. Seeds were soaked until they had absorbed amounts of water nearly sufficient for germination. They were then mixed with the soil to be tested, using an excess of seeds, and stirring from time to time, so that all particles of the soil came in contact with the seeds. Seeds in this condition have strong absorptive powers and are able to take water from a relatively dry soil and begin growth. Varying percentages of water were mixed with a particular soil, and the lowest percentage which would permit growth determined.

In a sand containing 0.15 per cent. (by dry weight) of water, seeds germinated after 19 days; while in a sample containing 0.09 per cent., the seeds did not germinate, but lost water to the sand. He made measurements with samples of clay, but did not compare the clay with the sand, since the amount of germination could not be accurately determined, and the temperatures in the two sets of experiments were not held alike.

Heinrich,[9] in 1894, determined the amount of water contained in soils when plants begin to wilt, and also determined the hygroscopic water content. The hygroscopic water was determined by

spreading the soils on a watch glass, and exposing them for one week to an atmosphere saturated with water vapor. The increase in weight was used as a measure of the hygroscopic water. His results show that, while the plant can live in a relatively dry soil, it can not use the hygroscopic water.

Edmond Gain[6] repeated the experiments of Sachs "with many plants in order to settle the following questions: (1) Is the power of resistance to drought of a given plant the same in different soils? This question must be answered in the affirmative. (2) Is the water content of the soil, at the time the plants wilt, the same for all stages of plant growth? No, it fluctuates in such a way as to produce a curve." He did not report the methods employed, nor give an analysis of the soils used.

A number of determinations of the amount of non-available water in various soils were made by King.[11] He concluded that one of the reasons why the clayey soils retained more water than the sands is because the small grains of the clay present more surface for retaining the water, the thickness of the film being the same in all cases. He gave a formula for computing the percentage of moisture in a soil which a given thickness of film will produce. By the use of this formula, a set of theoretical values was obtained, for the soils studied, which agree very closely with the percentages of non-available water found.

In 1902, Hedgcock[8] considered the relation of heat, light, and humidity to the amount of non-available water. His methods were such that he could not vary one factor while the others remained constant. The results as a whole would seem to show that any condition which lowers the vigor of the plant, raises the amount of non-available water. When he compared the various soils, he found that the amounts of non-available water retained by the soils increased in the following order: sand, loess, clay, loam, humus, saline soil. Judging from the sizes of the soil grains, the clay should have come after the saline, with the highest percentage. Hedgcock concluded that some factor other than the extent of soil surface is involved. The percentage of dissolved substances in the soil solution was the only condition noted that varied in the right direction. He, therefore, concluded that as the soil water diminishes, its concentration increases until finally

it becomes so concentrated that plants are unable to absorb more. He went so far as to formulate a law, that the percentage of non-available water in soils increases as the square root of the percentage of soluble salts.

Before using, all soils were sifted with a screen possessing a quarter-inch mesh. Other than this, the physical condition of the soil was not given closer attention than to list it as "loose, medium, or hard in density." A plant was considered, by him, wilted, when its youngest leaves wilt strongly. This would seem to be a very unreliable criterion, for many plants, at least. A geranium, for instance, will not only maintain its younger leaves, but will put out new shoots, after its roots have been killed. Many other plants behave in a similar manner.

Besides the above, a number of determinations of the amount of non-available water have been compiled, but aside from their local and immediate interest, they add nothing to our knowledge of non-available water.[10, 12, 17, 19]

ADSORPTION BY SOILS

The work done previous to 1908, on adsorption, has been recently reviewed by Patten and Waggaman,[14] so that a review of the literature need not here be given. The salient facts of interest in this connection are: Certain solids and liquids draw unto themselves and retain within their structures, or on their surfaces, other solids, liquids, or gases.* This is called *absorption.*

A special case of absorption, termed *adsorption*, is defined as the existence of a difference in concentration or density of a film adjacent to a bounding solid and the concentration or density of the mass of the liquid or gas which bathes the solid.†

Whether the relation between the adsorbing and adsorbed substances is physical or chemical, is not always clear; sometimes it appears to be one, sometimes the other. The difficulties involved in quantitative determination leaves us without a unit of adsorbing power, and with very few formulæ expressing the rate or conditions of adsorption.

When an adsorbent is brought into contact with a solution containing two or more solutes, these solutes may be adsorbed in

* *Loc. cit.* 10.

† *Loc. cit.* 11.

different degrees, so that a more or less complete separation of the solutes is effected. Further separation may be reached by using two or more adsorbents, each with an adsorbing power specific for each solute. A number of investigators have used organic substances, such as charcoal, paper, and cotton to effect such separations. The separation is seldom complete, the adsorbed substance being distributed between the adsorbent and the solvent. No general laws governing the ratios of such distribution have been established.

The solvent itself is often adsorbed, so that it increases very much in density at the surface of the adsorbent. This changes many of its physical characteristics; for instance, it is often able to hold the solute in solution at a concentration many times greater than normal saturation. This change in concentration is often accompanied by temperature changes which indicate enormous forces at work. The pressure of the water surface about a small solid (soil grain) has been estimated to have a magnitude of from 6000 to 25,000 atmospheres, or approximately 150,000 pounds per square inch.*

Now the soil grains present acres of surface to the soil solution, which, existing as it does, for the most part, in surface films is continuously within the field of adsorptive forces. We must expect, therefore, that adsorption will play important roles in the soil. Not only is the chemical content of the soil-solution affected, mineral nutrients stored up,[15] and toxins held harmless,[5] but the physical relations of the soil grains themselves are influenced.†

The field has been but little investigated, and most of the work has been done from the standpoint of physics and chemistry. Only a few investigators have taken up the problem from the standpoint of the plant, using it as an indicator. It would seem that this must be the ultimate point of attack, for the root hairs come into such a relation with the soil grains as to find a solution, the nature of which can be but little understood by any amount of study of the leachings from treated soils.

*Whitney, Soils of the United States. U. S. Dept. Agric. Bur. Soils Bull. 55: 11. 1909.

†Cameron, F. K. and Gallagher, F. E. Moisture content and physical condition of soils. U. S. Dept. Agric. Bur. Soils Bull. 30: —. 1908.

Not only this, but the root hairs, with their cellulose walls, are absorbents, and undoubtedly engage in selective absorption with the soil grains, so that there are ratios of distribution, between the soil grain, the film of soil water, and the cell wall.[18] Physiological processes in the plant will continually disturb the equilibrium of distribution. A series of changes must then follow before the equilibrium is again established. It was with the hope of getting some data regarding the nature of this equilibrium that the experiments described below were undertaken.

EXPERIMENTS AND RESULTS ON THE INFLUENCE OF SALTS ON NON-AVAILABLE WATER

From a number of plants used in preliminary experiments, wheat was selected as most suitable. Its superiority lies in the smallness of its seed, so that it early becomes dependent upon the soil solution, and in the tenderness of its leaves, which makes it very sensitive to a deficient water supply. Some of the plants were grown in paraffined baskets; others in flower pots dipped in hot paraffin. Both the baskets and the pots seemed to give good results, but the pots were easier to prepare. Later, when it was found, by weighing the empty pots, that they had slowly absorbed water, their use was discontinued. Glass tumblers were then tried, and were found very satisfactory. The roots spread evenly through the soil, showing no tendency to mat about the inner surface of the glass.

In the first experiments, the plants were grown in river-washed sand, but in the experiments from which the data given below were taken, the plants were grown in clean crushed quartz, obtained from a supply house. The chemical analysis of the quartz, furnished by the supply house, is as follows:

	Per cent.
Absolute silica	99.97
Iron, aluminum, calcium	.03
	100.00

The fresh samples were very white, but, after standing, a yellow tint, just perceptible when old samples were compared with new, was noted. This was probably due to thin films of iron oxide which formed on the surface of the grains.[4] The physical analysis is given in the table below:

	Size.	Per cent.
Gravel	2 mm. +	0.00
Fine gravel	1–2 mm.	0.00
Coarse sand	1–.05 mm.	3.60
Medium sand	0.5–0.25 mm.	20.51
Fine sand	0.25–0.1 mm.	72.72
Very fine sand	0.1–0.05 mm.	2.69
Total		99.52

A full nutrient solution was made up as follows:

		Gm.
Calcium nitrate $Ca(NO_3)_2+4H_2O$	15.83 gm. $=Ca(NO_3)_2$	11
Potassium nitrate	KNO_3	3
Magnesium sulphate $MgSO_4+7H_2O$	6.85 gm $=MgSO_4$	3
Potassium phosphate	KH_2PO_4	3
Total		20

Water to make 10,000 c.c. of solution.

This solution gives a concentration of salts equal to 0.2 per cent. The same stock solution was used throughout the entire series of experiments. To portions of this full nutrient solution, quantities of sodium chloride were added so that series of concentrations (salts of full nutrient solution plus sodium chloride) of the following order were made: 0.2 per cent. (control), 0.225 per cent., 0.25 per cent., 0.3 per cent., 0.4 per cent., 0.5 per cent., 0.65 per cent., and 0.8 per cent. In another series, the percentage of the total salts in the nutrient solution was increased, so that, without the use of the sodium chloride, the following series of concentrations were made: 0.2 per cent. (control), 0.25 per cent., 0.4 per cent., 0.6 per cent., and 0.8 per cent.

The solutions were made upon the percentage basis, because it is impracticable, when dealing with selective adsorption and water films, to make up solutions in the ratios of their osmotic strengths. Moreover, the questions in mind can be answered equally as well with simple percentage solutions.

Sodium chloride seemed a suitable salt to use since it does not readily penetrate plant protoplasm and since it ordinarily contains no water of crystallization. Further, Briggs[3] has shown that sodium chloride is but slightly adsorbed by quartz. The series without the sodium chloride served as a check on the purely toxic effects of the sodium chloride.

The quartz was wetted with the solution, so that it contained a 20 per cent. (20 grams of solution, plus 100 grams dry quartz)

soil moisture. The air-dry quartz was weighed out, to the 1/10 gram, in portions sufficient nearly to fill the tumblers. It was then spread over the bottom of a tray. The solution was added to the quartz in such a manner as to prevent, as far as possible, any uneven adsorption of the salts by the soil grains first wetted. After quickly mixing, the soil was dropped into the tumblers. When this quartz is carrying a 20 per cent. soil solution, it contains more than its optimum amount of water.* However, it was dropped into the tumblers in such a manner as to include air enough to supply the plants as long as it was necessary to grow them. By pounding the tumblers up and down on the table a few times, the inclosed air was worked out of the upper centimeter of the soil, which puddled, leaving a thin layer of free water on the upper surface. This also worked the air entrapped below the surface into quite large bubbles, the largest being about 5 mm. in diameter. The physical condition of the soil, thus obtained, appeared to be uniform throughout both series.

Melted paraffin was poured over the surface of the quartz in each tumbler, five small holes were made through the cover thus formed, and then the wheat seeds, which had germinated in Zurich germinators until the radicles were from five to ten millimeters long, were dropped through the holes into the water layer on the surface of the soil. Five tumblers of each concentration were set up.

The plants were grown in the glass house on a table in the center of the room, where they were under similar conditions, until they were ready to be wilted down. There was a marked difference, among the several concentrations, in the rate and amount of growth. With the exception of the 0.225 per cent. set, in which there was a stimulation, due undoubtedly to toxic effects, there was a regular decrease in both the rate and the amount of growth from the control set to that of the highest concentration. Plants that grew fastest used up their water first and were the first to wilt.

When the water was nearly used up, as was determined by repeated weighings of the tumblers, the plants were put into a

*It was necessary to use an excess of water so as to have enough to allow the plants to put on sufficient growth before wilting.

culture case, where a relative humidity of approximately 10 per cent. was maintained. The culture case, as described in another paper,[2] contained a thermograph, a hygrograph, and an electric fan. The humidity was controlled by regulating the volume of a stream of air, dried by passing through sulphuric acid, and forced into the case by means of an air pump.

Wilting the plants in a relatively dry atmosphere, practically solved the problem of knowing when to consider them wilted. These plants did not show temporary partial recoveries from the drouth effects, as others did which were grown under fluctuating conditions of humidity. Moreover, the leaves dried out immediately after death, so that it was possible to see the progress of death over the various members of the plant and to have each culture stopped at the same stage of wilting—a very important detail in non-available water determinations. A study to determine the effects of relative humidity on non-available water is now in progress, but the results of this study are not necessary for the present paper, since in the experiments here reported, all of the plants were under like conditions of humidity.

As soon as the plants had wilted, the tumblers were removed from the case, and the amount of non-available water determined in the following manner: The quartz was passed through a screen, having 20 meshes to the inch, which removed all the roots. A sample of about 80 grams of the quartz was put into an aluminum dish and weighed on a chemical balance.* The sample was then dried at 110° C. for one week. It was found that this amount of desiccation was sufficient to insure constant weight.

From the loss of weight in drying, the percentage of non-available water was determined, then the total water remaining in the soil was calculated, also the concentration which this water would have had, had it existed as free water,—assuming that the plants had used up none of the salts and neglecting any water of crystallization. The results of the determinations are given in the following table:†

*These operations were carried on in the laboratory and probably permitted some experimental error to enter. However, as little time as possible was consumed before the weighings were made. The sifting was done in a small closed vessel

†The numbers refer to the amount of salts added; thus 25a means that a 0.25 per cent. solution of sodium chloride and full nutrient salts were added to the quartz. Sets from *a* to *e* contain sodium chloride, sets from *l* to *p* contain no sodium chloride.

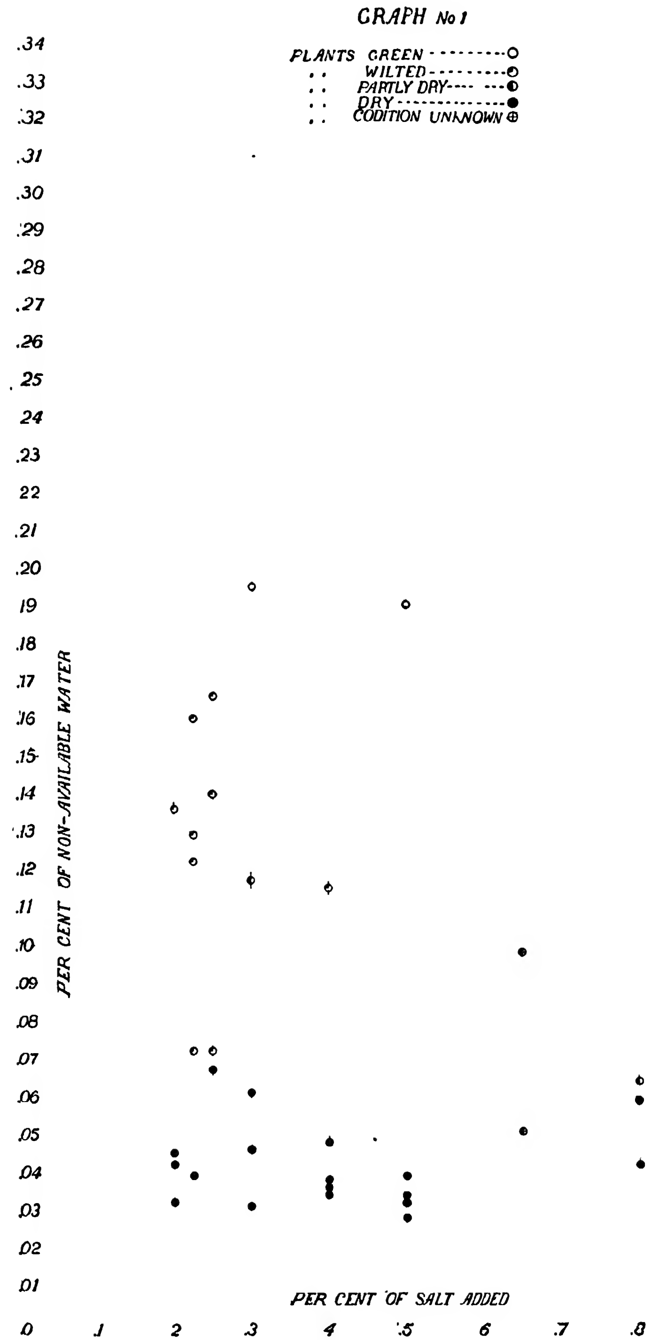
Number.	Amount of desiccation.	Per cent. of non-available water.†	Total concentration of all salts in per cent.	Concentration of sodium chloride in per cent.
2a	——	——	——	——
2b	dry	.03	125.	——
2c	wilted	.14	29.4	——
2d	dry	.05	87.	——
2e	dry	.04	94.	——
225a	wilted	.16	28.1	3.1
225b	wilted	.12	37.	4.1
225c	wilted	.07	62.5	7.
225d	dry	.04	115.7	12.9
225e	wilted	.13	34.8	3.9
25a	——	——	——	——
25b	wilted	.07	69.5	13.9
25c	wilted	.14	35.5	7.1
25d	dry	.07	74.8	15.
25e	wilted	.17	30.	6.
3a	dry	.03	192.5	64.2
3b	dry (partly)	.12	51.3	17.
3c	dry	.06	98 2	32.7
3d	wilted	.19	31.	10.3
3e	dry	.05	129.5	43.
4a	——	.04	206.	103.
4b	wilted	.11	69.1	35.
4c	——	.05	162.	81.
4d	——	.04	210.	105.
4e	dry	.04	231.	115.
5a	dry	.04	252.	151.
5b	dry	.03	315.	189.
5c	dry	.03	352.	212.
5d	green	.19	53.	32.
5e	dry	.03	312.	187.
65a	——	——	——	——
65b	——	.10	132.	91.5
65c	——	.05	254.	175.5
65d	——	——	——	——
65e	——	——	——	——
8a	green	.376	43.	31.
8b	dry	.06	275.	207.
8c	dry (partly)	.06	254.	190.
8d	green	.31	52.3	39.
8e	dry	.04	388.	292.
2l	dry	.18	27.2	——
2m	wilted	.25	16.	——
2n	dry	.06	55.	——
2o	wilted	——	——	——
2p	dry (partly)	.14	29.	——
25l	dry	.13	37.5	——
25m	dry (partly)	.18	27.5	——

†Recorded to nearest 1/100 per cent. only.

Number.	Amount of desiccation.	Per cent. of non-available water.†	Total concentration of all salts in per cent.	Concentration of sodium chloride in per cent.
25n	green	.34	15.	
25o	dry	.09	54.	
25p	dry	.05	98.	
4l	dry	.06	125.	
4m	dry (partly)	.15	52.5	
4n	dry	.09	90.	
4o	wilted	.25	32.	
4p	dry (partly)	.1	79.5	
6l	dry	.14	89.	
6m	dry	.09	128.5	
6n	dry	.09	141.	
6o	dry	.11	105.	
6p	dry	.09	140.	

The non-available water relations are more clearly represented by the graphs 1, 2, and 3. Graphs 1 and 2 are details of the sodium chloride and the full nutrient series, respectively. Graph 3 is a combination of 1 and 2, enlarging the scale of the ordinate 10 times, and indicating the determinations only in part. Referring to graphs 1 and 2, it will be seen that, with but a single exception, the amount of non-available water in the soil varies with the amount of desiccation which the plant has experienced. Cultures in which the plants are just beginning to wilt have the most; and those in which plants have dried have the least. Also, even in the culture containing the highest percentage of non-available water, the soil solution represents a concentration of 43 per cent. That the plant actually lived in these high concentrations is shown by the fact that in some cases the plants were still green when the sample was taken. Further, cultures in which plants are completely wilted, *i. e.*, plants just beginning to dry, have about 0.1 per cent. of non-available water, regardless of the amount of salts in the culture. Drawn across graph number 3, is a line representing the amount of water which the several sets had when the concentration of the soil water had reached 6 per cent. It is to be noted here that the plants in the cultures were not exposed to free water containing 6 per cent. of salt. The 6 per cent. curve lies so low that all the water in the quartz was in the form of *film water*, before this concentration was reached. No data have been found regarding isotonic values in film-water, a

†Recorded to nearest 1/100 per cent. only.


GRAPH No 1
PLANTS GREEN
WILTED
PARTLY DRY
DRY
CODITION UNKNOWN
PER CENT OF NON-AVAILABLE WATER
PER CENT OF SALT ADDED
.34
.33
.32
.31
.30
.29
.28
.27
.26
.25
24
.23
22
.21
.20
19
.18
.17
.16
.15
.14
.13
.12
.11
.10
.09
.08
.07
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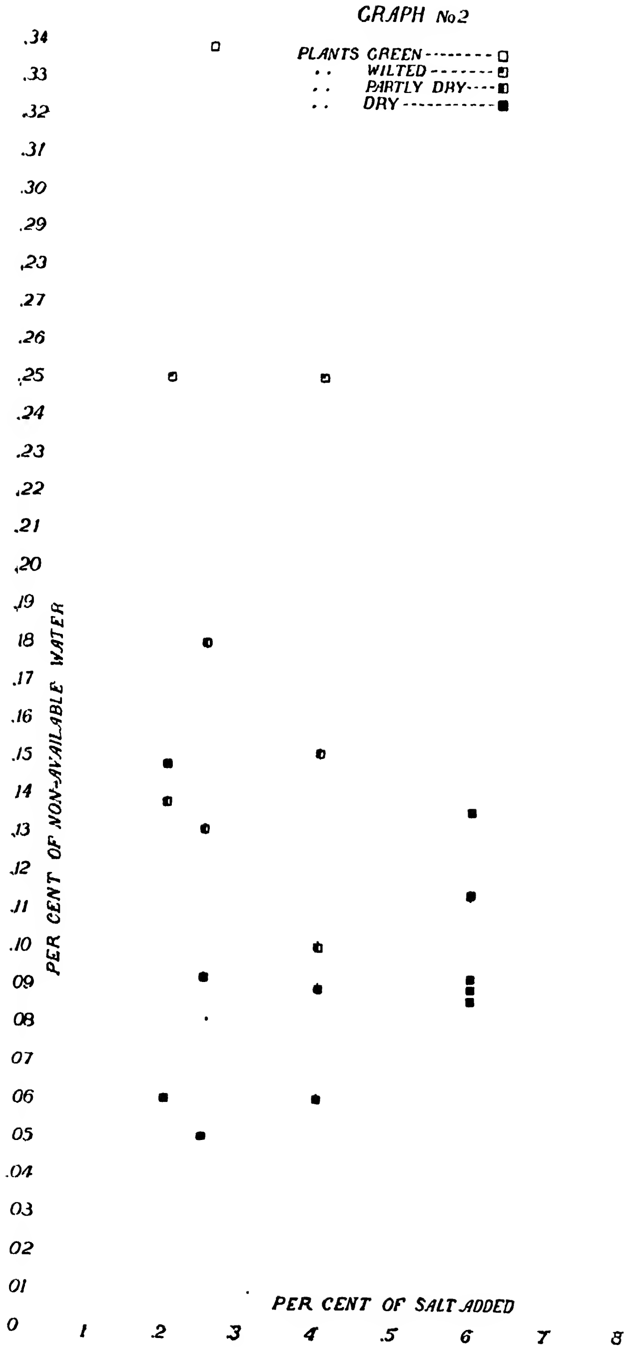
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8


GRAPH No2
PLANTS GREEN
WILTED
PARTLY DRY
DRY
PER CENT OF NON-AVAILABLE WATER
PER CENT OF SALT ADDED
.34
.33
.32
.31
.30
.29
.23
.27
.26
.25
.24
.23
.22
.21
.20
.19
18
.17
.16
.15
14
.13
.12
.11
.10
09
08
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05
.04
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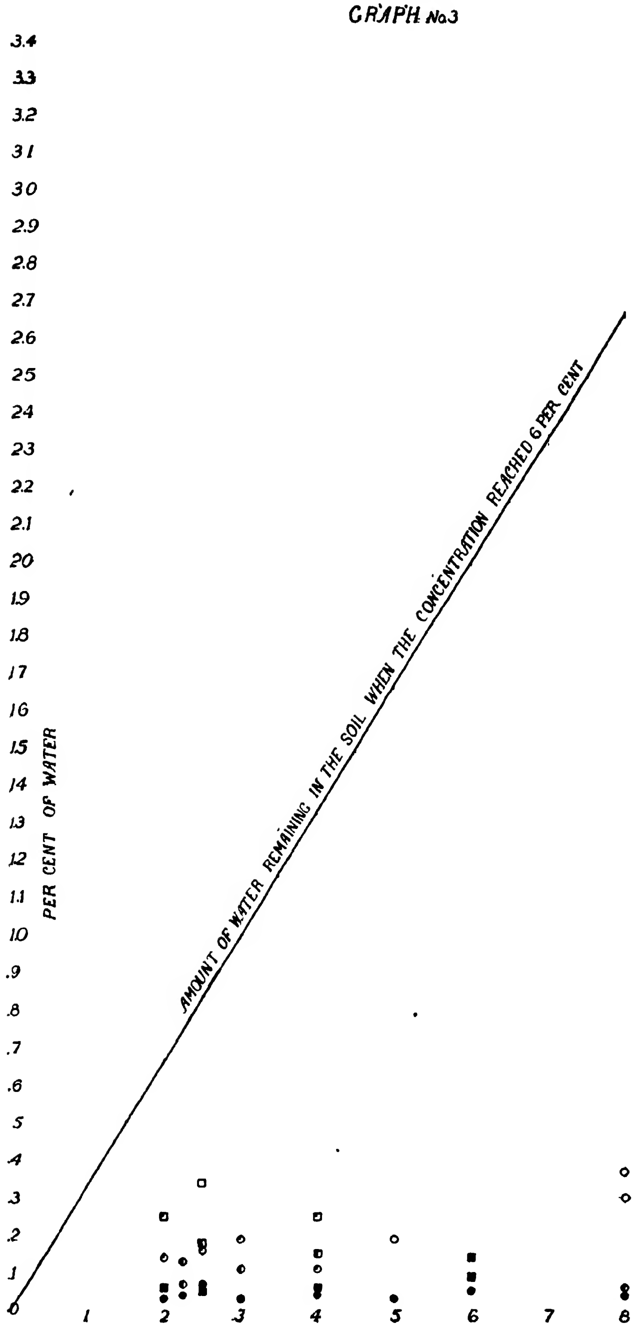
1
.2
3
4
.5
6
7
8


GRAPH No3
3.4
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
PER CENT OF WATER
AMOUNT OF WATER REMAINING IN THE SOIL WHEN THE CONCENTRATION REACHED 6 PER CENT
1
2
3
4
5
6
7
8

form of water which land plants use for a large part of their lives. The uniformity in the above results testifies to the smallness of experimental errors in sampling, weighing, et cetera.

The amount of non-available water was not determined in the 0.8 per cent. set of the full nutrient series, as these plants were used for a study of some of the physiological conditions of the plants at wilting time. One point, of vital interest here, is the amount of adjustment to concentrated solutions which the plants may have made.

The cell sap of the roots of normal wheat plants is isotonic with solutions which contain a concentration of sodium chloride lying between 3 per cent. and 6 per cent. A plant was removed from the tumbler of the 0.8 per cent. set, after all the plants in the tumbler, save this one, had wilted. The plant was removed by sluicing with a small stream of water, a number of uninjured root tips thus being obtained. The root tips were placed on a slide, under the microscope, and the concentration of the cell sap in cells of the tip was determined by the plasmolytic method. There was no plasmolysis with a 3 per cent. sodium chloride solution. A 6 per cent. plasmolyzed. Turgor was restored by tap water, the cells appearing normal in every way. The plants, therefore, did not adjust themselves to the various soil solutions by materially increasing the concentration of their cell sap.

There were, however, visible modifications in the plants due to the influence of the salts added. Increase in the amount of bloom, as mentioned by Harter,[7] was not observed, but there was a uniform decrease in the rate of transpiration. The leaves of the plants grown in the higher concentrations felt harsh to the fingers. A microscopical study of the leaves was not made, but possibly this harshness was due to some modification in the structure of the cell walls, as found by Harter. As mentioned above, there was a correlation between the size of the plants and the amount of salts added, the plants in the higher concentrations being much smaller. This is of special interest, for not only was the area of leaf surface reduced, in plants grown in the higher concentrations, but their root systems were proportionately reduced. In the 0.8 per cent. set the roots developed only in the upper one third of the tumblers. It follows, therefore, that the

roots of the plants in the higher concentrations came into contact with a much smaller proportion of the total surface presented by the soil grains. Yet, the percentage of non-available water, remaining in these tumblers, was no greater than that found in the lower sets, which indicates a water transfer from the more remote parts of the tumbler to the root systems of the plants. At first, when the soil was very moist, this transfer might have been made by the movement of the liquid water over the soil surfaces, but as these films became thinner, the movement would become slower, and at last, when the films became discontinuous, the movement would stop altogether. The only method of transfer, then, would have been in the form of vapor, and before the soil moisture could have been reduced to as low a percentage as was found in these experiments, this kind of transfer evidently must have taken place.

But little is known concerning the vapor pressure of soil moisture.[13] It may be expected, however, to vary with the shape of the film surfaces, with the surface tension, with the thickness of the film, and with the concentration of the solutes present. If, by a change in any of these conditions, the vapor pressure of the soil moisture about the roots is lowered below that of the surrounding soil, there will be a movement of water vapor toward the plant roots, and then a condensation. More than this, the water which permeates the plant roots together with their root hairs has a vapor tension and thus the roots must either give off water in the form of vapor or take it in, as they are in an atmosphere with a vapor tension either lower or higher than that of their own moisture. The common practice of growing plants in a damp chamber is evidence of this.

In the above-described experiments, the air cavities, in the quartz, were lined with projecting root hairs, which were often so numerous as to give the cavity the appearance of having walls covered with a delicate fur coat.

The writer has undertaken some further experiments in regard to the relation of plants to vapor tension; while no numerical results have been obtained, the preliminary experiments show that plant roots are very sensitive to variations in vapor pressure.

In regard to the influence of the concentration of soil moisture upon vapor tension and water transfer, the following experiment

has been completed. Five tall glass tumblers were selected, and 100 grams of dry river sand placed in the bottom of each tumbler. The sand in tumblers 1 and 2 was moistened with 10 grams of distilled water. To the sand in tumbler number 3, 10 grams of a 5 per cent. solution of sodium chloride were added. The sand in tumbler 4 was wetted with a 15 per cent. solution, and the sand in number 5 with 10 grams of a 20 per cent. solution of the same salt. A cloth diaphragm was then fixed in each tumbler, 3 centimeters

FIGURE 1. Apparatus for showing the influence of salt on vapor transfer in soils. Description in text.

above the sand, thus leaving a free air-space between it and the sand. One hundred grams of sand were placed upon the cloth diaphragms of each of the tumblers. This sand, in all of the tumblers except tumbler number 2, was moistened with 10 grams of distilled water. Tumbler number 2 had 10 grams of a 10 per cent. salt solution added to the sand above the diaphragm. After being sealed by tying sheet rubber over the top, the tumblers were then set in the basement, where there was but very slight variation in temperature (at least not more than occurs in field soils). After 10 days they were opened, and the amounts of water in the two layers of sand determined. As shown in the table, there

was, in every case, a transfer of water to the soil containing the salt solutions. Moreover, the transfer was made, by water in the form of vapor, across the air space. The water moved from the region of higher vapor pressure to the region of lower vapor pressure, and then condensed.

No.	Solution added below.	Solution added above.	Transfer of water in grams.	Direction of transfer.
1	Dis. H_2O	Dis. H_2O	1.35	down
2	"	10 per cent. NaCl	2.17	up
3	5 per cent. NaCl	Dis. H_2O	2.40	down
4	10 per cent. "	"	3.85	"
5	20 per cent. "	"	5.95	"

It will be noted that, in tumbler number 1, with distilled water both above and below the diaphragm, there was a transfer downward. This was probably due to the weight of the column of vapor in the glass. This difference was further shown by the difference in results from tumblers 2 and 4, where the condition in tumbler number 2 was the inverse of the condition in tumbler number 4, the salt solution being above the diaphragm in number 2, and below the diaphragm in number 4. In tumbler number 2, the water was transferred against the pull of gravity, while in tumbler number 4 the transfer was with the pull of gravity. As expected, the amount of transfer in number 4 was greater than that in number 2. It is possible that water condensed in drops on the sides of the glass and, in some cases, ran down. This error, however, is not very large, and could not explain the results of number 2, nor the regular curve which all the results produce when plotted. Furthermore, there was no visible evidence of such a transfer. The amount of transfer in number 3, which had a concentration of soil moisture of the same magnitude as that of my cultures some time before the plants wilted, would have been sufficient to have raised the percentage of soil moisture to within the limits of available water.

CONCLUSIONS

1. In these experiments, it has been shown that the amount of non-available water is not influenced by adding to pure quartz the quantities mentioned above of either sodium chloride or the salts of a full nutrient solution.

2. Practically all plants of economic value are land plants, and hence, for both their water and food supply, are dependent on water

films. Therefore, it is important that we understand the conditions of equilibrium between the plant and this form of water.

3. It is apparent that the isotonic values determined for substances dissolved in free water do not necessarily hold for film-water. We cannot thoroughly understand the acquisition of water and food by land plants, or the results from fertilizer experiments until some of these values are known. Further, the conditions of equilibrium *in film water* must be determined for both toxic and "balanced" solutions, before we have reached a logical stopping place for these lines of research.

4. The investigations should be carried out with carefully controlled experiments, in which the number of unknown factors is reduced to a minimum. Fundamental principles will scarcely be demonstrated by experiments on soils chosen at random in the field. Such soils contain too many unknown factors. Experience shows that experiments from soils from the same locality may not yield comparable results. The soil used should be of simple composition, and its content known. We must have a number of simple standardized soils, of which samples can be duplicated. I have used a soil with comparatively few unknown factors, and one that is to be had in practically unlimited amounts. These experiments can be duplicated.

5. Much of our knowledge of the relation of plants to the soil must be obtained by indirect methods. A great deal of it must be worked out in the laboratory of the physical chemist. But all such results should be checked up by experiments with the plant itself, for the problem of the relation of plants to the soil is primarily a problem in botany, both in its inception and final solution.

The greater part of this work has been done under the direction of Professor C. Stuart Gager, whose suggestions and encouragement have been invaluable in its prosecution.

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The embryo-sac of Pandanus coronatus

Douglas H. Campbell

The Pandanaceae are generally regarded as one of the lowest families of the monocotyledons. For this reason it seemed worth while to examine the embryo-sac to determine whether it showed any evidence of primitive characters in its structure.

Material was collected in Java in 1906, and a preliminary examination showed very marked departure from the ordinary angiospermous type. An account of the results of this investigation has already been published.*

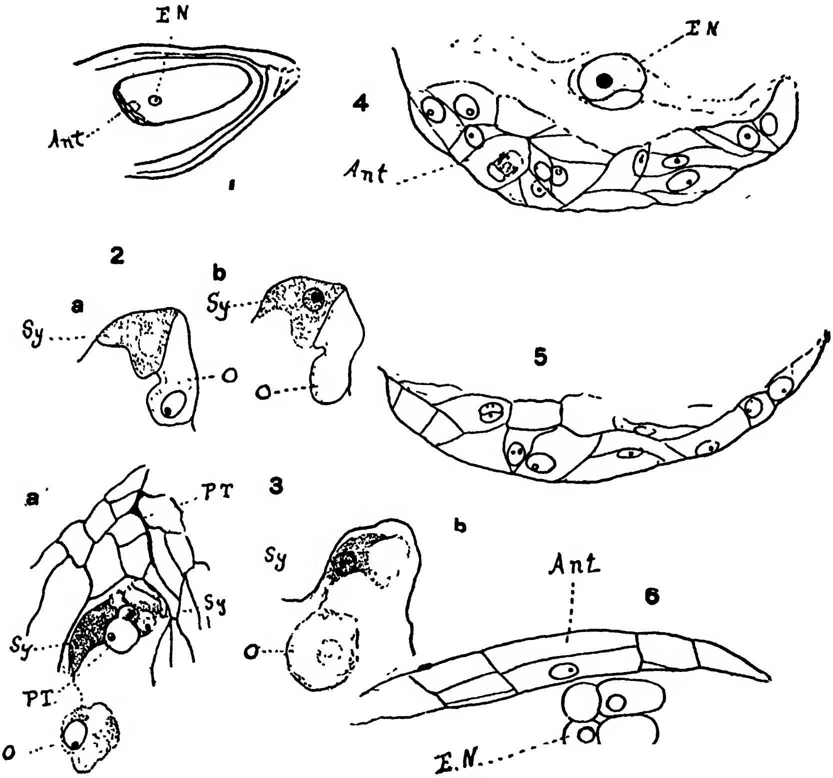
The oldest stages secured from my Javanese material showed fourteen nuclei in the embryo-sac instead of the eight nuclei found in typical angiosperms. Of the fourteen nuclei, two were at the micropylar end of the sac, the others at the chalazal end. It was impossible to tell whether this stage represented the condition at the time of fertilization, and further efforts were made to obtain material which would settle this important question.

Through the kindness of Dr. W. R. Shaw, of Manila, I have received a large amount of material, very carefully preserved, which has furnished the stages of development that were desired. Dr. Shaw writes that the species is probably *P. coronatus* Martelli —a name supposed to be synonymous with *P. tectorius* Soland. Preparations made from this material showed a number of instances in which the pollen-tube was entering the embryo-sac, and a comparison of these with the latest stages found in the material from Java showed that the latter were by no means mature.

Pressure of other work has made it impossible at this time to present a detailed account of the development of the later stages of the embryo-sac, but it is hoped later to prepare a full account of the development both of the embryo-sac and embryo. The present note is intended to give a description only of the structure of the embryo-sac at the time of fertilization.

*Bull. Torrey Club 36: 205–220. *pl. 16, 17.* 1909.

FIGURE I shows a section of an ovule containing the nearly mature embryo-sac. At the micropylar end is a nearly typical egg-apparatus consisting of two synergids and the elongated egg, *o*. These are shown more enlarged in FIGURE 2. At the chalazal end is a large discoidal mass of cells, the antipodal cells, the exact number of which was not ascertained, but it probably is variable. Above the antipodal tissue are two large free nuclei which probably



Explanation of figures 1–6

1. A nearly median section of an ovule of *Pandanus coronatus*, shortly before fertilization, × about 35.

2. Two sections of the egg-apparatus from the same embryo-sac, × 320; *Ant.*, antipodal cells; *E.N.*, polar nucleus; *Sy*, synergid; *o*, egg-cell.

3. *a*. Upper part of a somewhat older ovule, showing the entrance of the pollen-tube, *P. T.*, × 320. *b*. The second synergid and egg from the same.

4, 5. Two sections of the antipodal cells from the embryo-sac shown in fig. 2. There were three "polar" nuclei, *E. N.*

6. Antipodal region from an embryo-sac with six polar nuclei, of which four are shown in the figure.

represent the polar nuclei of the ordinary embryo-sac. In this specimen the pollen-tube had not yet reached the nucellus.

Several somewhat older stages were also examined, some of which showed the entrance of the pollen-tube. In FIGURE 3 the pollen-tube is seen within the embryo-sac—where it has partially destroyed one of the synergids. Two small nuclei, probably the generative nuclei, could be seen within the pollen-tube. The egg, *o*, lay some distance below the synergids, but this was probably due to displacement in mounting the sections. Two sections of the antipodal region are shown in FIGURES 4 and 5. There were three polar (?) nuclei, apparently in process of fusion.

In another specimen (FIGURE 6) there were six "polar" nuclei.

It is thus evident that at the time of fertilization, the embryo-sac of *Pandanus* has a very much larger number of cells than that of the typical angiosperms, this being shown both in the increased number of antipodal cells, and that of the "polar" nuclei.

It still remains to be seen what is the relation of the "polar" nuclei to the egg-apparatus and to the antipodals.

The embryo-sac of *Pandanus* most nearly resembles that of *Sparganium*, but in the latter the increased number of antipodal cells arises subsequently to fertilization, and there are but two polar nuclei. The structure of the embryo-sac tends to confirm the view that the families Pandanaceae and Sparganiaceae are really closely related. (See arrangement of the families of monocotyledons in Engler & Prantl, Die Natürlichen Pflanzenfamilien.)

STANFORD UNIVERSITY,
CALIFORNIA.

Some new Hawaiian plants

JOSEPH F. ROCK

Pittosporum Hosmeri Rock

Arbor 6.5–10 m. alta, ramis robustis; folia coriacea, 90–125 mm. longa, 18–38 mm. lata, oblanceolata, obtuse acuminata, supra glabra, subtus lanuginosa, petiolo tomentoso 12–25 mm. longo; capsulae maturae 3 aut 4 in pedunculo 12–20 mm. longo, lignosae, glabrae, oblongo-subquadrangulatae, 55–75 mm. longae, 45 mm. latae; semina nigra, rugosa, 6–7 mm. diam.

A tree 6.5–10 m. high, with a straight trunk and rather stout branches, young shoots pubescent; leaves crowded at the ends of the branches, coriaceous, 90–125 mm. × 18–38 mm., oblanceolate, bluntly acuminate, the upper side glabrous and wrinkled with a close net-work, covered underneath with a silvery gray wool, entire, gradually narrowing into a pubescent petiole of 12–25 mm.; open mature capsules single or 3 or 4 on a woody peduncle of 12–20 mm. and pedicels of 2 mm., thick-woody, oblong to subquadrangular, 55–75 mm. × 45 mm., opening into two, three, or sometimes four valves with a longitudinal median groove, glabrous when old, covered with a grayish brown wool when young; endocarp bright orange-colored, seeds black, rugose, 6–7 mm. in diameter. The fruits exude a milky glutinous sap. Flowers not collected. [FIGURE 1.]

This tree is rather common on the lava fields of Puuwaawaa, Hawaii, at an elevation of 3,000 feet. The species is remarkable for the unusually large woody capsules which open into two, three, and sometimes four valves. (Native name Aawa hua kukui.)

The type number is 3957 in the herbarium of the Board of Commissioners of Agriculture and Forestry, Territory of Hawaii. Collected at an elevation of 3,000 feet. (*J. F. Rock*, June 17, 1909.)

Named in honor of Mr. R. S. Hosmer, Superintendent of Forestry, Hawaii.

Sideroxylon rhynchospermum Rock

Arbor 10–20 m. alta; folia coriacea, obovato-oblonga, 14–18 cm. longa, 4.5–8 cm. lata, petiolo 2.5–3 cm. longo, alterna, stipulis 0, prorsus glabra, folia novella tomentosa; calyx fere usque ad basin partitus, segmentis 5, acuminatis, imbricatis; corolla lutea,

FIGURE 1. *Pittosporum Hosmeri* Rock. Slightly less than one half the natural size.

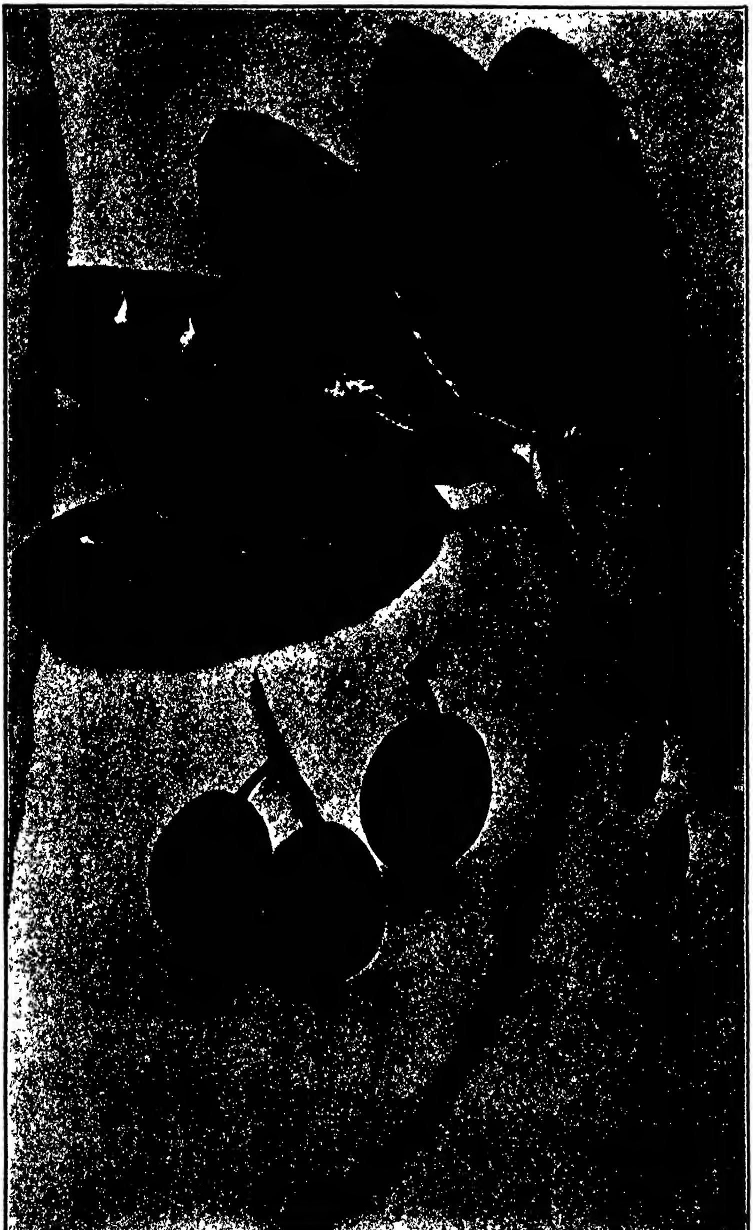


FIGURE 2. *Sideroxylon rhynchospermum* Rock. Showing foliage fruit, and seeds. Two fifths the natural size.

campanulata, lobis 5; stamina glabra, ad basin corollae affixa; stylus brevis; bacca ovoidea, purpurea vel nigra, 4.5–5.5 cm. × 3.5–4 cm.; semina 3–5, testa crustacea nitida, plana, rostrata, 25–30 mm. longa, 12–14 mm. lata.

A tree 10 m.–20 m. high, dividing freely into ascending branches; bark brownish, with shallow, narrow longitudinal corrugations about 3 mm. thick, trunk up to 45 cm. in diameter four feet from the ground; leaves coriaceous, obovate-oblong, 14–18 cm. × 4.5–8 cm., on petioles of 2.5–3 cm., alternate, estipulate, quite glabrous with age, some pubescence remaining on the sides and angles of the midrib and veins, especially on the lower surface, shining above, dull beneath, midrib prominent, with lateral veins leaving midrib at wide angles (about 80° in center of leaf) parallel to margin and connected by a continuous intra-marginal nerve, young leaves densely covered with appressed brown hair on both surfaces; flowers in clusters 2 or 3 (?) on tomentose pedicels, 12–20 mm. long; calyx 5-parted to near the base, lobes imbricate, acuminate, 3–5 mm.; corolla light yellow, longer than the calyx, 4–5-parted to the base, the lobes acute; staminodia half as long as the lobes, linear, with a faint nerve; stamens 5, inserted at the base of the corolla, glabrous; anthers erect, ovate, the cells confluent at the apex, opening laterally; ovary hirsute, 5-celled, style short-conical; fruit a purple or black plum-like berry 4.5–5.5 cm. × 3.5–4 cm., rather fleshy, 3–5-seeded; seeds enclosed in a papery pyrena, 25–30 mm. × 12–14 mm., flat, beaked at both ends of the ventral angle, which is occupied by the scar of the raphe, the crustaceous testa thin, of a light brown color. [FIGURE 2; FIGURE 3, *a*, *b*.]

This tree was discovered by Dr. H. L. Lyon, pathologist of the Hawaiian Sugar Planters' Experiment Station, in the woods of Nahiku, Maui, at an elevation of 1,300 feet, where he collected the type material. Dr. Lyon observed one large tree at Kailua, Maui, which had a straight trunk fully 30 feet to the first branch.

The type is number *6061*, given by Dr. Lyon for the herbarium of the Board of Commissioners of Agriculture and Forestry, collected January 15, 1909, at Nahiku, Island of Maui.

Lysimachia glutinosa Rock

Frutex 10–12 dm. altus; folia alterna, chartacea, obovato-oblonga, acuminata, 38–102 mm. longa, 12–30 mm. lata, petiolis longitudine 12 mm.; pedicelli axillares, ex axillis foliorum superiorum; calyx fere usque ad basin partitus; corollae rotato-campanulatae, albae, lobis 5–8, ovatis; capsula lignosa, ovata, 5–10 valvis dehiscens; semina numerosa.

A diffusely branching shrub 10–12 dm. high, glutinous; leaves alternate, chartaceous, entire, obovate-oblong, acuminate, 38–102 mm. × 12–30 mm., narrowing into a winged petiole of 12 mm., upper

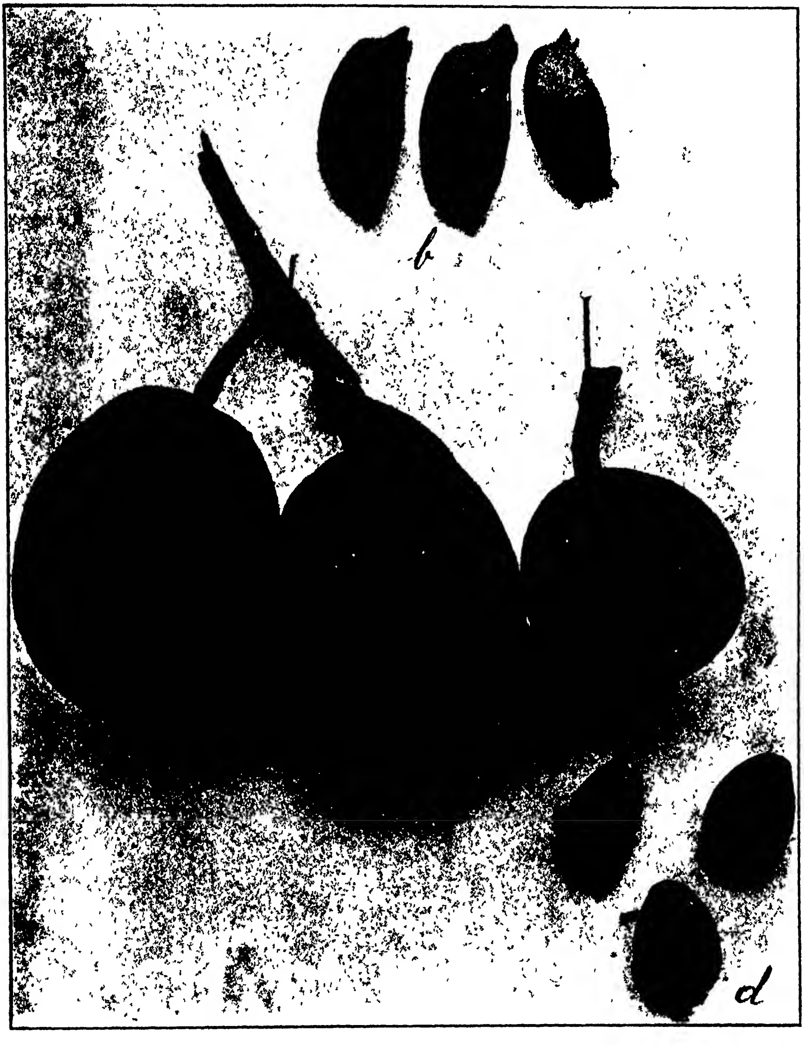


FIGURE 3. *a, b, Sideroxylon rhynchospermum* Rock.; *c, d,* fruit and seed of *S. sandwicense* Benth. & Hook., introduced for comparison. Slightly reduced.

face covered with a glutinous exudation, underneath glabrous and pale with prominent nerves; inflorescence viscid; flowers solitary in the axils of the upper leaves on pedicels of 38 mm. (50–76 mm.

when with fruit); calyx persistent, with ovate-lanceolate acute lobes free to near base, and half the length of the corolla, punctate; the imbricate corolla large, rotate-campanulate, cream-colored, 25–38 mm. in diameter, cut deeply into 5–8 ovate lobes, tube 4 mm. long; stamens half the length of the corolla or little more, the rather long filaments united at the base by a granular membrane,

FIGURE 4. *Lysimachia glutinosa* Rock. One half natural size.

anthers erect; style little shorter than the stamens; capsule ovoid, smooth, 12 mm. or more long, lignescent, glossy inside, opening by 5–10 valves; seeds numerous. [FIGURE 4.]

This plant is sometimes covered with hair, flies, and dirt, which adhere to the very viscid inflorescence and leaves; the large showy

flowers are of striking beauty (February to March). In the herbarium the dried specimens leave large oil spots on the paper.

The type is number *1770*, in the herbarium of the Board of Agriculture and Forestry of the Territory of Hawaii, collected on

FIGURE 5. *Dubautia Waialealae* Rock. Slightly less than one half the natural size.

the highest ridge west of Halemano, Kauai, on rather open places at an elevation of 4,500 feet (February 14, 1909). A few shrubs were seen in the woods back of Kalalau.

Dubautia Waialealae Rock

Planta hirsuta, 2–3 dm. alta; folia coriacea, 15–20 mm. longa, 4–6 mm. lata, terna, sessilia, oblanceolata; capitula 5–10 mm. diam., hirsuta, in pedicellis 4–27 mm. longis; corymbus foliaceus; involucrum angustum, bracteis 5–6; receptaculum conicum, hirsutum, paleis 14–18; corollae luteae; pappi paleae lanceolatae, ciliatae; achaenia parce pilosa.

Whole plant hirsute, 2–3 dm. high, with stout woody branches covered with leaf-scars throughout; leaves thick-coriaceous, crowded, 15–20 mm. × 4–6 mm., ternate, sessile, oblanceolate, acute, narrowing below, remotely denticulate in the upper half, covered with small stiff whitish hairs on both sides, many-nerved; flower-heads 5–10 mm. in diameter, hirsute on pedicels of 4–27 mm. in groups of 4–18 at the ends of the branches, corymb foliaceous; involucral bracts 5 or 6, almost as high as the heads; receptacle conical, covered with long white hairs, paleae 14–18; florets 6–30; corolla bright yellow, slightly exserted, deeply 5-cleft, lobes reflexed; pappus chaffy, the narrow lanceolate ciliate paleae as long as the hispid straight achenes.

The type number is *5030* in the herbarium of the Board of Agriculture and Forestry of the Territory of Hawaii; collected (September 24, 1909) at the summit of Mt. Waialeale, Kauai, at an elevation of 5,250 feet, where the plant grows in company with *Geranium humile*, *Lobelia kauaiensis*, *Pelea Waialealae*, and *Drosera longifolia.*

BOARD OF AGRICULTURE AND FORESTRY,
HONOLULU, HAWAII.

A new fossil fucoid

Arthur Hollick

(with plate 33)

Among a number of unidentified specimens recently subjected to critical examination in connection with the work of arranging the paleobotanical museum of the New York Botanical Garden, was one of an unusually well-defined, almost perfect frond of a fucoid. The original label reads "*Haliserites* sp. (near *H. Dechenianus* Göpp.). Devonian. Franklin, Delaware Co., N. Y."; but neither the name of the collector nor the date of collection is recorded.

The locality indicated is within the Devonian area of the state, and the specimen, if dismembered, would resemble very closely, in its parts, certain Devonian fucoid remains from the same general region, referred to the genus *Haliserites* by D. P. Penhallow.* In the paper cited a number of fragmentary specimens are described and figured under the names *Haliserites Dechenianus* Göpp., *H. Dechenianus lineatus* var. nov., and *H. lineatus* sp. nov. They apparently merely represent different parts of a single species, and if all were combined the combination would resemble quite closely a portion of the specimen now under consideration. They are all described as having dichotomously forked branches— the only specific differences being the characters described, respectively, as "equally and strongly costate throughout," "midrib well-defined throughout" and "costate throughout, costa not prominent." The figures, however, fail to show these latter characters in a satisfactory manner in any instance and none of them gives any idea of the size or shape of the frond. Under the circumstances, therefore, it would be inadvisable to assume specific identity between our specimen and any one or all of these fragmentary remains, although it would be entirely justifiable to regard them as identical generically.

*Notes on Erian (Devonian) plants from New York and Pennsylvania. Proc. U. S. Nat. Mus. 16: 105–114. *pl. 9–14.* 1893.

Another contribution dealing with the same subject is by David White,* in which two fine specimens, more or less closely resembling ours in general aspect, are described and figured under the new generic and specific name *Thamnocladus Clarkei*, and he remarks (p. 598) that "the fossils of the species here described as *Thamnocladus clarkei* have generally been recorded in American literature under the name *Haliserites dechenianus* Göpp." He regards such specific identification as doubtful, however, and contends, with excellent reason, that in any event none of the specimens of this species, European or American, should be referred to the genus *Haliserites* as originally described and figured by Sternberg,† and then proposes (p. 603) the generic name *Taeniocrada* to include the American forms referred by Penhallow to *Haliserites* and also certain similar European species of the genus (*H. distans* Eichw. and *H. lusaticus* Gein.), but is doubtful about including the specimens figured by Göppert as *H. Dechenianus*. The type species of the genus *Taeniocrada* is stated to be *T. Lesquereuxii* David White MSS. (no. 25164, Lacoe collection, U. S. Nat. Mus. Catskill beds, Factoryville, Pa.), represented by Penhallow's *f. 6 pl. 10* (*loc. cit.*), under the name *Haliserites Dechenianus* Göpp.

Apparently it was White's intention to maintain the two genera, *Thamnocladus* and *Taeniocrada*, as distinct, but if so his intention is not very clearly expressed and is liable to be misinterpreted. It may also be pertinent to remark that it is entirely a matter of personal opinion whether or not they should be so regarded, and, from a careful consideration of all the available evidence, I am inclined to the opinion that the facts do not warrant their separation.

If, therefore, we regard all of Penhallow's specimens as representing a single species, and accept White's view that this species is probably not *Haliserites Dechenianus* Göpp., and his conclusion that, in any event, it can not belong in the genus *Haliserites* Sternb., the questions to be decided are, first, whether or not our specimen is identical with any species heretofore described, and

*Description of a fossil alga from the Chemung of New York, with remarks on the genus Haliserites Sternberg. Rep. N. Y. State Paleontologist **1901**: 593–610. *pl. 3, 4.* 1902.

†Fl. Vorwelt **2**: 34. *pl. 24. f. 7.* 1833.

second, under what generic name it should be placed in order that it may conform to accepted rules of nomenclature.

Taking all of the facts and circumstances into consideration, it seems advisable to describe our specimen under the name

Thamnocladus passifrons sp. nov.

Frond irregularly branching from a short expanded base, apparently flat throughout and somewhat extended laterally, surface smooth and shining; branches dichotomously forked at varying intervals, mostly incurved above each bifurcation, gradually diminishing in width from about 5 mm. below to 1 mm. at the ultimate extremities, obscurely costate in places; costae median?

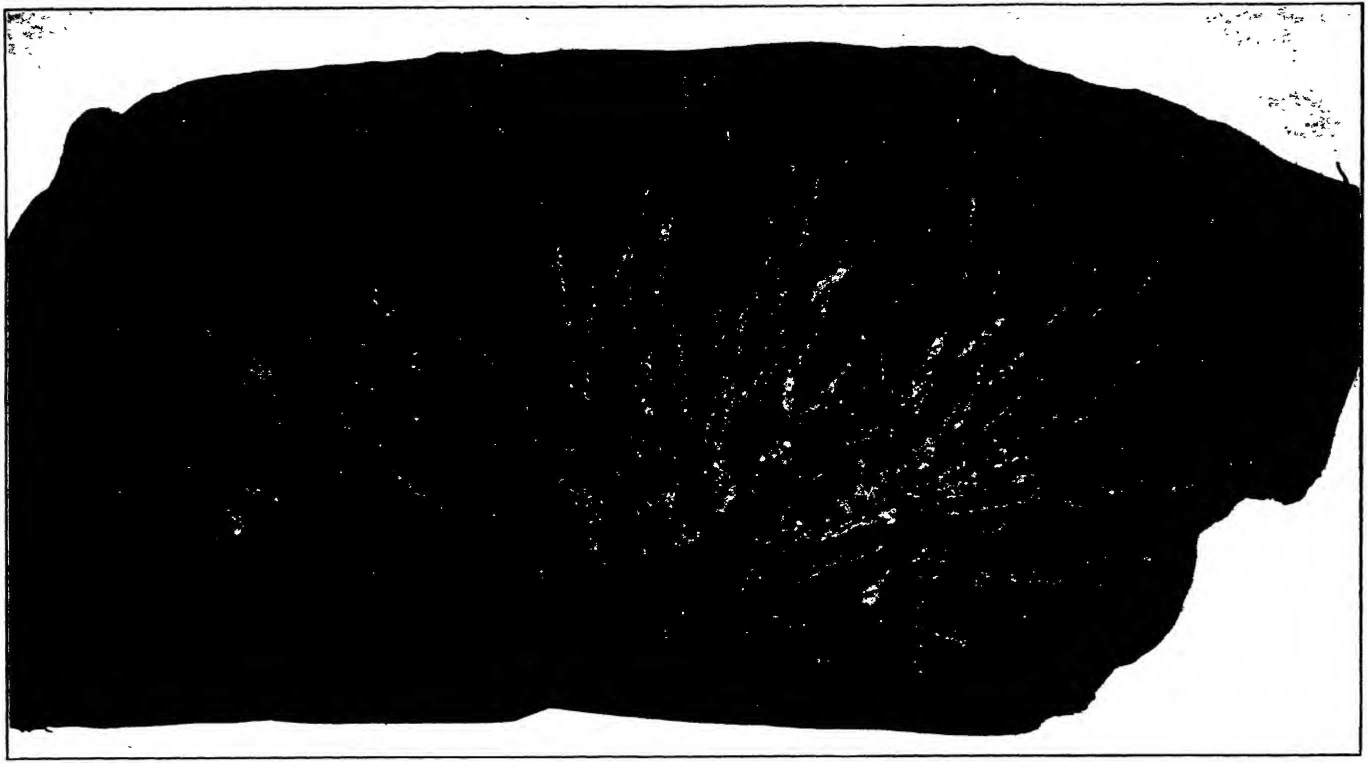
In red shaly sandstone.

Devonian (Catskill group), Franklin, Delaware County, New York.

Type in the museum of the New York Botanical Garden.

Explanation of plate 33

Thamnocladus passifrons Hollick. From a photograph of the type specimen, natural size.



THAMNOCLADUS PASSIFRONS HOLLICK

The name Buthotrephis gracilis Hall

Edwin W. Humphreys

While engaged in the work of identifying and naming certain of the specimens in the paleobotanical museum of the New York Botanical Garden my attention was called to the confusion that obtains in connection with the use of the name *Buthotrephis gracilis* Hall; and in the hope of establishing hereafter the correct application of this name it has been deemed advisable to present the following account of its origin, together with a brief discussion of the principles of nomenclature that are involved with it:

In 1843 Hall* described and figured a fossil fucoid from the Clinton group, under the name *Fucoides gracilis*.

In 1847† he described and figured a similar fossil from the Trenton limestone, under the name *Buthotrephis gracilis*.

In 1852‡ he described and figured another specimen from the Clinton Group under the name *Buthotrephis gracilis*, and included with it, as a synonym, his *Fucoides gracilis*, followed by the note "Not *B. gracilis*, Pal. N. York, Vol. 1, pag. 62, pl. 21, fig. 1. The species of the Clinton group will retain this name by precedence, and that of the Trenton limestone may be changed to *B. tenuis*."

From a consideration of the above facts it may be appreciated that in common usage the name *Buthotrephis gracilis* Hall might be meant to indicate either one of the two species which Hall regarded as distinct from each other and as representing two distinct and rather widely separated geologic horizons. A critical study of literature relating to the subject has shown this to be the case and, further, that the changes in nomenclature suggested by Hall have received but scant attention on the part of most writers. These conditions have, in consequence, led to more or less confusion, and to considerable doubt in many instances as to which species is meant where a fossil fucoid is referred to as *Buthotrephis*

*Nat. Hist. N. Y. Pt. IV, Rept. Fourth Geol. Dist. 69, *f. 14*.

†Ibid., Pt. VI, Paleont. N. Y. 1: 62. *pl. 21. f. 1*.

‡Ibid., Pt. VI, Paleont. N. Y. 2: 18. *pl. 5. f. 1a–1d*.

gracilis Hall. This is especially true in the case of local lists of fossils, as for instance in such a list from the Trenton limestone of any locality, in which the name may be found included, without comment or adequate description, and the intention of the author of the list can only be inferred. The probability, of course, is that he is referring to the Trenton limestone species, but on the other hand he may be announcing the discovery of the Clinton *B. gracilis* in the Trenton limestone. Hence it is frequently more or less hazardous to draw conclusions in regard to the areal or stratigraphic distribution of the species recognized as *Buthotrephis gracilis* from such lists or other similar publications.

In this connection, as an indication of the extent to which the application of correct nomenclature has been disregarded, the following data may be of interest:

In sixty-five references to *Buthotrephis gracilis* Hall, twenty-three were found to refer more or less clearly to the Trenton species and twenty-four to the Clinton species, while in regard to the remaining eighteen it was impossible to hazard more than a guess as to which species the author had in mind. From among all of these references, therefore, more than one fourth were useless as a basis for accurate conclusions or inferences.

In twenty-six references to what was clearly intended to mean *Buthotrephis tenuis* Hall, twenty-three referred to it as *B. gracilis*, but fortunately with more or less plain indications as to which species was meant, while in the three remaining references only was it called *B. tenuis*.

Finally, attention is called to the fact that in accordance with our accepted rules of nomenclature the binomial *Buthotrephis gracilis* Hall, 1847, by reason of priority of publication, must be applied to the Trenton species, and the name *B. tenuis*, which he subsequently proposed for it, in 1852, becomes merely a synonym. Further, his transfer of the Clinton species, *Fucoides gracilis*, to the genus *Buthotrephis*, in 1852, required that this species be renamed, for the reason that the original specific name, *gracilis*, had been previously combined with *Buthotrephis* to represent the Trenton species. As this has not heretofore been done, so far as I am aware, the name *Buthotrephis Hallii* is now proposed for the Clinton species, in honor of the founder of the genus.

The synonymy of the two species may therefore be given as follows:

Buthotrephis Hallii nom. nov.

Fucoides gracilis Hall, Nat. Hist. N. Y. Part IV, Rept. Fourth Geol. Dist. 69. *f. 14.* 1843.

Buthotrephis gracilis Hall, ibid., Part VI, Paleont. N. Y. **2**: 18. *pl. 5. f. 1a–1d.* 1852. Not *B. gracilis* Hall, ibid. **1**: 62. *pl. 21. f. 1.* 1847.

BUTHOTREPHIS GRACILIS Hall

Nat. Hist. N. Y. Part VI, Paleont. N. Y. **1**: 62. *pl. 21. f. 1.* 1847.

Buthotrephis tenuis Hall, ibid. **2**: 18 [note under synonymy]. 1852.

Studies on the Rocky Mountain flora — XXII

PER AXEL RYDBERG

ERIGERON

Just as the writer resumed his work on *Erigeron*, Coulter and Nelson's New Manual of Botany of the Central Rocky Mountains came out. From all evidences it is apparent that most of the work in connection with the new book has been done by Professor Aven Nelson, of the University of Wyoming. The work is a great improvement on the old Coulter's Manual and it is perhaps the best manual that has been put out treating on the botany of the West. It has, however, many features to which the present writer is unwilling to subscribe. Dr. B. L. Robinson in his recent review* has pointed out the unevenness in the nomenclature, in that the Vienna Code has been followed in some cases, in other cases not. But this is easy for me to understand, for Professor Nelson has until lately followed the "Rochester Code," and it is not so easy to change the nomenclature of one's thinking and writing and make it self-consistent.

A few years ago, when Professor Nelson published his "New Plants from Wyoming" in the Bulletin of the Torrey Botanical Club, he was about as "radical" as the present writer, and had about the same limitation of species. If we should judge from the New Manual, his conception of a species seems to have changed considerably, as seen from the number of specific names reduced to synonymy. Whether this change of attitude has slowly grown upon Professor Nelson or is due to influence from his collaborators, I can not tell. There is, however, one feature in this connection that seems to me somewhat unexplainable. Professor Cockerell in his review† of the book stated:

"I have had the curiosity to count the number of species admitted as valid in the new manual, which were undescribed at the time of the publication of the first edition in 1885. They

*Rhodora **12**: 13–16. Ja 1910.

†Science II. **31**: 302. 1910.

number 787, about 28 per cent. of the whole flora . . . Of the 787, no less than 244 were proposed by Professor Aven Nelson himself; 152 are by Dr. Rydberg, of the New York Botanical Garden, and 148 by Dr. E. L. Greene, now of the U. S. National Museum, but at one time a resident of Colorado. . . . The number of species accepted as valid is 2,733, while no less than 1,788 specific names are rejected as synonyms or insufficiently known. Many of those latter were proposed by Professor Nelson himself, more by Rydberg and Greene."

Why should more (nearly 66 per cent. more) of Professor Nelson's species be acceptable and "many more" of Dr. Greene's and my own be reduced to synonymy? Not counting the time before the first edition of the Manual of the Rocky Mountain Region appeared, Dr. Greene published on the flora for ten years, between 1885 and 1895, when practically no work was done by Professor Nelson or myself, and he has published at least twice as many new species from the Rocky Mountain Region as Professor Nelson. Both Dr. Greene and myself have had access to much larger herbaria and libraries than has Professor Nelson, and have seen specimens from the Rockies which he has not seen. The New Manual, therefore, seems to show a decided partiality for the species proposed by Professor Nelson himself. Some partiality would be expected, but in this case it seems out of proportion. Professor Nelson is a very conscientious worker, and it would be unjust to claim that this imparity in treatment was intentional. The main cause, I think, is that he had not seen the types or authentic material of many of the species so reduced. He knew his own species, but not all of those proposed by other botanists. It was not fair to them simply to reduce their species to synonymy, if such species were unknown. If question-marks had been added to show probable synonymy, the matter would have been improved considerably. There are many cases in which I am confident that Professor Nelson had no specimens illustrating species reduced to synonymy.

Some years ago I spent considerable time on *Erigeron* as repre-ented in the Rockies and had seen the type or a duplicate of the type of nearly every species described. In fact, I knew the genus (one of the largest in the region) as well as any of the composite genera. That I should have resumed the work on that genus just

as I received the New Manual was a curious coincidence. There is scarcely a genus, in which I, from my standpoint, could pick out so many flaws of treatment in the New Manual. This paper, therefore, has become an adverse criticism of the New Manual, more so than I had intended or wished.

The way in which the authors of the New Manual have determined what species should be regarded as good and which names should be reduced to synonymy, is rather interesting. Many of Dr. Greene's species and my own have been reduced, while others of older authors and of Nelson's have been kept up. The uneven treatment, as I have said before, is due in some cases to the fact that the authors had not seen the types. *Erigeron lapiluteus* A. Nels. (*E. yellowstonensis* A. Nels.) is regarded as distinct from the exceedingly close *E. droebachensis*, and *E. trifidus* from *E. compositus;* while *E. jucundus* Greene is made a variety of the little related *E. acris* L., *E. multifidus* Rydb. is made a synonym of *E. compositus*, and *E. flabellifolius* Rydb. one of *E. trifidus*. The fact is that *Erigeron multifidus* Rydb. is much closer to *E. trifidus* than to *E. compositus* and grades directly into it. The typical *E. compositus* is rare and more distinct. I think, though, that they are all three forms of one species, while *E. flabellifolius* has nothing to do with either. It has a stoloniferous rootstock instead of a cespitose caudex and the leaves do not at all suggest *E. trifidus* but are more like those of *Ranunculus Eschscholtzii* in outline.

Erigeron conspicuus Rydb. is made a synonym of *E. speciosus* DC. In the herbarium of Columbia University there is a duplicate of the type of *E. speciosus* DC., collected by Douglas. In this the stem and leaves are perfectly glabrous except the ciliate margins of the latter and the plant is closely related to *E. macranthus* Nutt., perhaps not distinct. *E. conspicuus* Rydb. is considerably hairy on both the stem and the leaves, and if reduced should be included in *E. subtrinervis* Rydb. rather than in *E. speciosus*. If the type of *E. conspicuus* were placed before a student and he used the key of the New Manual, it would be named *E. subtrinervis*.

Both *Erigeron salicinus* Rydb. and *E. platyphyllus* Greene are made synonyms of *E. macranthus* Nutt. While the first is

closely related to that species, the second can scarcely be said to be so. Its habit, foliage, and pubescence are those of *E. subtrinervis* and only the involucral bracts are those of *E. macranthus.*

Erigeron incanescens Rydb., *E. eximius* Greene, and *E. viscidus* Rydb. are all made synonyms of *E. formosissimus* Greene. The first has a hirsute involucre and is related to *E. subtrinervis;* the third and fourth have glandular-puberulent involucre and may well be united. The authors have included *Erigeron formosissimus* also among the annuals or biennials, though it is evidently a perennial. The third has also glandular involucres, but is almost glabrous and should have been included in *E. asper* of the New Manual if reduced.

Erigeron glabellus Nutt., *E. consobrinus* Greene, *E. oblanceolatus* Rydb., and *E. Earlei* Rydb. are made synonyms of *E. asper* Nutt. *E. glabellus* and *E. Earlei* have perennial branched rootstock; the rest are biennial with tap-roots. They may perhaps sometimes be perennial, but there is no evidence of a branched rootstock. In *E. glabellus* the pubescence is spreading, in *E. Earlei* closely appressed.

Erigeron nematophyllus Rybd. is made a synonym of *E. Eatonii* A. Gray. The latter is not uncommon in Utah, where I have collected it myself. A duplicate of the type is in the Columbia University herbarium. It has narrowly linear-oblanceolate, distinctly triple-nerved basal leaves and decidedly flattened achenes. In *E. nematophyllus* the leaves are almost filiform and strictly one-nerved. Evidently Professor Nelson did not know *E. Eatonii*, for what he has distributed under that name is *E. nematophyllus.* The only specimens of the real *E. Eatonii* from Wyoming in our collections are from Wind River Mountains, and there collected by Merrill & Wilcox and by Tweedy.

Erigeron curvifolius Piper is made a synonym of *E. luteus* A. Nels., although they are not closely related, the former being a coarsely hirsute plant, with leafy stem, the latter being a closely strigose subacaulescent plant. It would have been much better to reduce Nelson's own *E. luteus* to a synonym of *E. peucephyllus* A. Gray, to which it is closely related.

Erigeron Parryi Canby & Rose, *E. Scribneri* Canby, and *E.*

vetensis Rydb., are made synonyms of *E. radicatus*. *E. vetensis* has an involucre of two series of subequal bracts, a simple pappus, consisting of bristles only, of which some are occasionally shorter. Both *E. Parryi* and *E. Scribneri* have 3 or 4 series of bracts, more imbricated and more flat, obovate-cuneate achenes and double pappus, the outer squamellate. Both are closely related to *E. montanensis*, which Nelson refers to *Wyomingia*.

ERIGERON YELLOWSTONENSIS A. Nels. Bot. Gaz. **31**: 198. 1900

Erigeron lapiluteus A. Nels.; Coult. & Nels. New Man. Cent. Rocky Mts. 530. 1909.

Professor Nelson states in the New Manual that *Erigeron yellowstonensis* is a name to be rejected, but he does not state on what ground, probably because it is of barbaric origin, regarded from a Latin standpoint. But what should be said about *E. lapiluteus* which is to replace it? Is it Latin? It is probably meant to be derived from *lapis*, stone, and *luteus*, yellow. In making a compound word the Romans usually took the stem of the first word and connected it with the second word by means of the connecting vowel *i*. The stem of *lapis* is *lapid*, as seen from the genitive *lapidis*. The proper form would then have been *lapidiluteus*. But what would that have meant? Usually the Romans placed the modifying word first (not always though), as is done in the English, and the name *Erigeron lapidiluteus* would mean the "stone-yellow fleabane." The intention was evidently to name it the "fleabane of the yellow stone." The only proper way to express this would be by the specific name *lapidis lutei* or, as it has become the custom in botany to capitalize proper names, and use a hyphen when the specific name consists of more than one word, *Lapidis-lutei* or *Lutei-lapidis*, as the order of the adjective is indifferent.

Professor Nelson states also that "the variety *droebachensis* [of *E. acris*] probably does not occur in our range." *Erigeron droebachensis* Muell., is as common in the Rockies as is *E. yellowstonensis*. The question is whether they should be kept apart specifically. The only difference I can find is that the latter is more hairy with shorter hairs, decidedly glandular-puberulent in the inflorescence, and the involucre is more decidedly hirsute. In the

herbarium of the New York Botanical Garden there are several Scandinavian specimens of *E. droebachensis* Mueller (*E. Muelleri* Lund.), one from the vicinity of Christiania; the town of Droebach is only a short distance south of Christiania. These specimens are perfectly matched by specimens from Quebec, Subarctic America, Yukon, Canadian Rockies, and Colorado. *Erigeron acris* L., which is included in the New Manual, is on the contrary not found in America. It differs from all the North American species of the group, except the very rare *E. alpinus*, in having villous rather than hirsute or puberulent involucres.

ERIGERON COMMIXTUS Greene, Pittonia **5**: 58. 1902

E. cinereus A. Gray, Mem. Am. Acad. **4**: 68. 1849. Not *E. cinereus* H. & A. 1836.

E. colo-mexicanus A. Nels.; Coult. & Nels. New Man. Cent. Rocky Mts. 529. 1909.

Another specific name proposed by Professor Nelson, *Erigeron colo-mexicanus*, to replace the untenable *E. cinereus* A. Gray, is in my opinion rather distasteful. Fortunately I do not need to use the name, as the same species has been described by Dr. Greene under the name *E. commixtus*.

ERIGERON UNIFLORUS L. Sp. Pl. 864. 1753

The typical form of this species is, so far as I know, not found on this continent. As Dr. Greene has pointed out, the European species is characterized by narrow erect or ascending rays. This character is found also in *Erigeron pulchellus unalaschkensis* DC. Prod. **5**: 287 (*E. uniflorus pulchellus* Fries), which is not uncommon in America from Greenland to Labrador, Montana, and Alaska. In the latter the involucre is more or less turbinate, tapering into the enlarged end of the stem, and black-hairy, while in the typical *E. uniflorus* the involucres are hemispheric, and more or less white-hairy, and the stem is not thickened. Whether the two are specifically distinct or not is hard to tell. In Greenland both forms are found. If the variety is to be regarded as a species, **Erigeron unalaschkensis** (DC.) is the only available name, as *E. pulchellus* has been used by Michaux for another species.

The plant referred to *Erigeron uniflorus* in the Flora of Colorado

is distinct and easily distinguished by its broad spreading rays. The name it should bear is *E. simplex* Greene. *E. leucotrichus* Rydb. is a more luxuriant form of the same. It is questionable if *E. melanocephalus* Nelson should not be included in it also, differing only in the blackish hairiness of the involucre.

Professor Piper in his flora of Washington has transferred the name *Erigeron filifolius* (Hook.) Nutt. to what was usually known under the name *E. peucephyllus* A. Gray. This change was wholly unwarranted, I think. There are duplicates of the types of both *Diplopappus filifolius* Hook. and *Erigeron filifolius* Nutt. in the Columbia University herbarium, and they both belong to the species described under the latter name in Gray's Synoptical Flora. What probably led Professor Piper astray was the following words in Hooker's description: "*radiis flavescentibus.*" This does not necessarily mean that the plant has yellow rays. The original meaning of *flavescens* is turning (light) yellow. White flowers often turn yellowish in drying. As *E. filifolius* has white as well as violet rays, the rays are often yellowish in drying.

WYOMINGIA

As instituted in the New Manual this genus is very unsatisfactory, for if the more imbricated bracts with thickened backs are made the distinguishing character separating *Wyomingia* from *Erigeron*, then *E. Garrettii* A. Nels., *E. tener* A. Gray, *E. Tweedyi* Canby, *E. caespitosus* Nutt., *E. nevadensis* A. Gray, *E. luteus* A. Nels., *E. filifolius* Nutt., etc., should be included in *Wyomingia.* If the achenes should count for anything, *E. montanensis* and perhaps *E. canus* could not very well be included. The former has flattened achenes and the latter has glabrous and 8–10-nerved achenes, while the rest of the genus has pubescent and 4–5-angled achenes. It would be desirable to take out *Wyomingia* as a genus, for the plants fit rather poorly in *Erigeron*, but the question is where to draw the line. The species with flattened achenes with the involucre of *Wyomingia* would constitute a rather natural genus, but such species as *E. utahensis* destroy the distinctness.

ANTENNARIA

A footnote under this genus in the New Manual states: "The treatment of this genus is largely an adaptation of Professor Elias

Nelson's clear and discriminating revision of a large part of the genus." While Elias Nelson's treatment is in the main excellent, the writer is inclined to take some exceptions to this as well as to that of the New Manual. In the latter we find the following key of the *A. alpina* group:

Stems very slender, 2–7 cm. high. 1. *A. media.*
Stems medium, 8–15 cm. high.
  Leaves broadly spatulate; involucres 6–7 mm. high. 2. *A. fusca.*
  Leaves spatulate-oblanceolate; involucres about 5 mm. high.
    Leaves obtuse, tomentose. 3. *A. reflexa.*
    Leaves acute, canescent. 4. *A. umbrinella.*

The only species that can be separated out by this key is *Antennaria fusca*. The key is not workable otherwise. *A. media* is often 8–10 cm. high and *A. umbrinella* and *A. reflexa* are often less than 7 cm. high. In both *A. reflexa* and *A. umbrinella* as limited in the New Manual and in E. Nelson's paper are the leaves both tomentose and canescent, as the one word indicates the kind of pubescence, and the other word the color of the same. E. Nelson merges *A. mucronata* E. Nels. in *A. umbrinella* Rydb. and *A. flavescens* Rydb. in *A. reflexa* E. Nels. Under the latter he makes the following statement: "In describing *A. umbrinella* Dr. Rydberg confused two species . . . The male and female plants of his type are of different species. One of these he later named *A. flavescens*, and the staminate plants of this and his *A. umbrinella* are identical." It is true that there were a few staminate specimens of *Antennaria flavescens* mixed in the type collection of *A. umbrinella*, but there were also a few staminate specimens of the latter. I saw the plant in field, as I was present when Professor J. Flodman collected the type, but we did not then notice that another species was growing with it. The staminate plants of *A. umbrinella*, *A. flavescens*, and *A. reflexa* are very much alike and hard to separate. *A. flavescens* has somewhat narrower bracts and the leaves are usually more or less yellowish and with a very fine and closely appressed silky tomentum. The difference between the staminate plants of *A. umbrinella* and *A. reflexa* I can not describe. The staminate plant of *A. mucronata* is very different, more resembling that of *A. media*, but the inner bracts are nearly white, the outer very dark brown. E. Nelson states that typical staminate plants are unknown. The only ones I

have seen and which I think belong here are *Goodding 430*, from Ten Sleep Lakes, Big Horn County, Wyoming, and labeled *A. nardina*.

The pistillate plants of the four species are easier to distinguish. *Antennaria mucronata* has very dark greenish brown bracts, as dark as those of *A. media* but the inner bracts are oval, obtuse or even rounded at the apex, and inclined to be white-tipped. The leaves of the rosettes are narrower and with more appressed pubescence. The bracts of the pistillate head of *A. umbrinella* have about the same shape as those of *A. mucronata* but are from light umber-brown to almost yellowish, and of the same color throughout. The leaves are much shorter and broader, like those of *A. media*, but with appressed tomentum. The bracts of the pistillate heads of *A. flavescens* are still lighter than those of *A. umbrinella*, being yellowish or brownish white, oblong and scarcely more than half as broad, but still obtuse. The leaves are yellowish. It would have been better to have designated *Rydberg & Bessey 5146* instead of *5145* as the type, because the former number contains pistillate as well as staminate plants. The pistillate heads of *A. reflexa* have bracts of a color similar to that of *A. umbrinella* but they are decidedly acute and resemble those of *A. media* in shape.

The staminate plants of this group are very rare, except in *Antennaria flavescens*, in which it is the common form, the pistillate plant being comparatively rare. In the herbarium of the New York Botanical Garden the staminate plants are represented by the following specimens:

Antennaria alpina (L.) Gaertner: *J. Källström* (Tronfjeld, Norway).

A. monocephala DC.: *Wm. Horne* (Karluk, Alaska), *Blaisdell* (Cape Nome, Alaska).

A. media Greene: *Hall & Chandler 686* (Mt. Goddard, Calif.); *Sonne 160* in 1888 (Bear Creek, Placer Co., Calif.) and in 1892 (Coldstream, Calif.).

A. mucronata, E. Nels.: *L. Goodding 430* (Ten Sleep Lakes, Wyo.).

A. umbrinella Rydb.: *Flodman 859* (partly) (Long Baldy, Mont.); *Macoun 69339* (Meyer's Creek, B. C.); *Umbach 615* (Midvale, Mont.); *Rydberg & Bessey 5164* (Mt. Chauvet, Idaho); *Shear & Bessey 3971* (Steamboat Springs, Colo.).

A. flavescens Rydb.: many specimens.

A. reflexa E. Nels.: *Goodding 114* (Pedro Mountains, Wyo.); *Goodding 380* (Doyle Creek, Wyo.); *A. Nelson 853* (Union Pass, Wyo.).

A. pulvinata Greene: *Richardson* (?), from Hooker's herbarium.

Antennaria rosea (D. C. Eat.) Greene has a peculiar history. The citation of Eaton should perhaps be omitted, for Eaton* gave no description. The first description was given by myself under the name *A. parvifolia*,† on the supposition that it was the same as *A. parvifolia* Nutt.‡ It might have been included partly in the description of that species, but Professor Piper has shown that Nuttall's type belongs rather to *A. aprica* Greene. It was afterwards described by Greene as *A. rosea*,§ the author giving *A. dioica rosea* Eaton as a synonym. As that was a *nomen nudum*, it should be "ignored" as Greene|| stated later, and *A. rosea* is based wholly upon Greene's description. The type of *A. rosea* would then be *Sheldon 128*, which is first cited, rather than *Watson 652*, which is not cited at all. *Sheldon 128* is the monotype of Greene's *A. sordida*.¶ The proposer of the latter must have forgotten or ignored what he had done a year earlier. E. Nelson gives *A. sordida* as a synonym of his *A. rosea angustifolia*, based on my *A. angustifolia*.** There is no use of keeping up a variety if the type of the species belongs to the variety! Besides, *Sheldon 128* and *Watson 652* are almost identical. *A. angustifolia* Rydberg is somewhat similar, but has narrower involucral bracts, of which the inner are very acute. It is not found in the Rocky Mountain region.

In the New Manual, *A. anaphaloides* Rydb. is made a synonym of *A. pulcherrima*. Piper, who is fully as "conservative" as A. Nelson, keeps them distinct, however. So did also E. Nelson. The description of *Antennaria pulcherrima* in the New Manual is an almost verbatim copy of my description of *A. anaphaloides*. The description, especially that of the pistillate head, does not

*Bot. King Exp. 186. 1871.
†Bull Torrey Club 24: 301. 1897.
‡Trans. Am. Phil. Soc. II. 7: 406.
§Pittonia 3: 281. 1898.
||Pittonia 4: 81. 1899.
¶Pittonia 4: 81. 1899.
**Bull. Torrey Club 26: 546. 1899.

at all agree with a duplicate of the type of *A. pulcherrima* in the Torrey herbarium. In the latter, the bracts are imbricated in 6 or 7 series, wholly brown, the innermost very narrow and acuminate. *A. foliacea* Greene is wholly ignored, although E. Nelson had it in his paper. *A. Sierrae-Blancae* Rydb. is made a synonym of *A. rosulata*, although the words "leaves glabrate above" are added after the reference. Probably the authors had not seen any specimens. The characters of the bracts (not referred to) are a better distinction than the mere lack of tomentum. On the other hand, *Antennaria oblanceolata* Rydb. is kept distinct from the closely related *A. luzuloides*. In the key the latter is placed under the heading "bracts tomentose except the scarious tips"; but in the description is stated "involucres glabrous nearly or quite to the base." The latter characterization is correct and *A. luzuloides* should be associated with *A. oblanceolata* instead of *A. pulcherrima* in the key.

Antennaria acuta sp. nov.

A surculose-stoloniferous perennial; stems slender, 5–12 cm. high; stolons short and mostly ascending; basal leaves and those of the stolons narrowly oblanceolate, greenish-white, tomentose on both sides, glabrate in age, 15–25 mm. long, 2–4 mm. wide, acute or abruptly short-acuminate; tomentum very fine and appressed; stem-leaves narrowly linear or linear-oblanceolate; heads 3–5, conglomerate, sessile; involucres about 6 mm. high, tomentose below; bracts of the pistillate heads lanceolate to linear-lanceolate, dark greenish brown with slightly lighter tips, the inner acute.

This is related to *Antennaria alpina* and *A. media*. It resembles perhaps most the former but the leaves are equally tomentose on both sides. From *A. media* it differs in the narrower, acute or acuminate leaves with a finer, closely appressed tomentum.

ALBERTA: Marsh near Lake O'Hara, Aug. 8, 1904, *J. Macoun 65423* (type in herb. N. Y. Bot. Gard., duplicate in herb. Geol. Surv. Canada); also Bow River at Laggan, July 25, 1904, *65413;* and Pipestone Creek, July 6, 1904, *65422.*

GNAPHALIUM

In Coulter & Nelson's New Manual both *Gnaphalium sulphurescens* Rydb. and *G. thermale* E. Nels. are cited as synonyms of

G. Wrightii. G. thermale is closely related to that species and may be regarded as a form thereof by a conservative systematist, but the first one named is not.

At the end of the description of *Gnaphalium Wrightii* the following note is given: "*G. thermale* E. Nels. Bot. Gaz. **30**: 121. 1900, the description of which is here used." If *G. thermale* is to be included in *G. Wrightii*, it is at least not the normal condition of that species and the description of the small *G. thermale* gives a poor idea of *G. Wrightii*, which is a tall plant, 3–5 dm. high. To use the description of one species for another is as a rule very unsafe, unless the identity is established without any doubt.

Gnaphalium albescens Osterh., *G. proximus* Greene, and *G. lagopodioides* Rydb. are not accounted for at all in the New Manual, although they were described from material collected in the region covered by the work. The first, I think, is a pure synonym of *G. Wrightii;* the other two, as well as *G. sulphurescens*, are closely related to *G. chilense* Sprengel (*G. Sprengelii* H. & A.). All three have the obtuse bracts and subdecurrent leaves of that species. *G. proximus* was based on *Aven & Elias Nelson 6036* and is closest to *G. chilense.* The specimens were distributed as *G. Sprengelii* and are evidently included in *G. chilense* in the New Manual. If *G. sulphurescens* should be reduced to synonymy it should be under *G. chilense* not under *G. Wrightii.*

Gnaphalium uliginosum L. is also omitted, although it has been collected in both Colorado and Utah.

Gnaphalium angustifolium A. Nels. is antedated by both *G. angustifolium* Lam. and *G. angustifolium* Loisel.; but as those species now are referred to *Helichrysum* it may be that *G. angustifolium* is tenable according to the Vienna Rules. A poor rule indeed, when the validity of the name *G. angustifolium* A. Nels. depends upon whether two species of the Old World are kept in *Gnaphalium* or not. Three years after *G. angustifolium* A. Nels. was published, the proposer of that species substituted the name *G. exilifolium*, which name is wholly ignored in the New Manual.

Gnaphalium Williamsii sp. nov.

Probably biennial; stem 3–6 dm. high, branched above, loosely floccose; leaves linear or linear-lanceolate, decurrent, 5–10 cm. long,

almost equally floccose on both sides with loose, not dense tomentum, sometimes slightly glandular; inflorescence large, corymbosely paniculate; heads somewhat conglomerate at the ends of the branchlets; involucre hemispheric or nearly so, 6 mm. high, only slightly tomentose at the base; bracts broadly ovate, acute, light straw-colored or white; achenes glabrous; pappus straw-colored.

This species is intermediate between *Gnaphalium microcephalum* and *G. decurrens*; perhaps more closely related to the latter, of which it has the general habit and the larger nearly hemispherical involucres, but the leaves are nearly as tomentose above as beneath. They are slightly if at all glandular; the stem is not at all so. The pubescence is that of *G. microcephalum* but the inflorescence is more open and inclined to be flat-topped and both the involucre and its bracts are much broader.

MONTANA: Columbia Falls, Aug. 11, 1894, *R. S. Williams* (type, in herb. N. Y. Bot. Gard.); woods, Belton, Aug. 25, 1903, *Umbach* 752.

NACREA A. Nels.

I believe that this genus is based on the essentially staminate plant of *Anaphalis*. There is a duplicate of the type of *Nacrea lanata* in the herbarium of the New York Botanical Garden, but the specimens are so young that the real structure of the flowers can not be made out. It may be that Nelson had better developed material on hand. The expressions "akenes (immature in these specimens)" indicate, however, that he did not have developed fruit. The so-called staminate flowers of *Anaphalis* are in reality hermaphrodite flowers with sterile pistils. (See Bentham & Hooker, Genera Plantarum.) The styles in them are undivided and the achenes remain undeveloped. In the description of *Nacrea* there is nothing said about the styles being undivided or 2-cleft. In the herbarium of the New York Botanical Garden there are two specimens collected in the Big Horn Mountains, one by T. A. Williams in 1898, and the other by Dr. H. Hapeman in 1892, which (especially the first mentioned) are so close in every respect to the duplicate of the type of *Nacrea lanata*, that anybody would take them for the same species. They are better developed and belong without doubt to an *Anaphalis*. Whether they can be separated specifically from *A. subalpina* is doubtful.

Anaphalis angustifolia sp. nov.

Perennial with a creeping rootstock; stems slender, strict, simple, white-tomentose, 3–6 dm. high; leaves narrowly linear, 1-nerved, 5–10 cm. long, 2–5 mm. wide, ascending, densely white-tomentose beneath, less so above, greener and often glabrate in age; inflorescence small, corymbiform, 2–3 cm. high, 3–4 cm. wide; heads hemispheric; involucres about 5 mm. high; bracts pearly white, elliptic, obtuse or acutish.

This species is more related to the eastern *Anaphalis margaritacea* than to *A. subalpina*, having narrow and 1-ribbed leaves, but differs in the smaller inflorescence, smaller heads, narrower bracts, and narrower and ascending instead of spreading leaves.

MONTANA: Mount MacDonald, July, 1900, *Elrod & assistants* (type, in herb. N. Y. Bot. Gard.); Big Fork, Aug. 9, 1901, *Umbach 15*.

BALSAMORRHIZA

Professor Nelson has reduced *Balsamorrhiza hirsuta* Nutt. and *B. terebinthacea* Nutt. to varieties of *B. Hookeri* and *B. macrophylla* respectively. Although the first has a superficial resemblance in the cutting of the leaves to *B. Hookeri*, it is much more closely related to *B. macrophylla* in every respect, differing only in the smaller heads and more dissected leaves. In his key Professor Nelson gives the following characters:

Leaves entire or somewhat toothed.	1. *B. sagittata.*
Leaves not entire, laciniately dentate to bipinnatifid.	
Green, glabrous or sparingly hisute.	2. *B. macrophylla.*
Canescent or lanate.	
The sericeous pubescence appressed or spreading.	3. *B. Hookeri.*
The white tomentum often floccose.	4. *B. incana.*

How would it be possible to locate *B. Hookeri hirsuta* by means of this key? As its leaves are pinnatifid, green, and hirsute, it would key into *B. macrophylla* instead of *B. Hookeri*. On the following page Professor Nelson gives only the following: "The pubescence roughish hirsute and spreading, not canescent or tomentose," as distinguishing the var. *hirsuta* from *B. Hookeri*, just the same characters which he in the key has used as separating *B. macrophylla* from *B. Hookeri*. The latter is not found within the range.

Balsamorrhiza terebinthacea Nutt. is not closely related to *G.*

macrophylla. In the latter the outer involucral bracts are elongated and reflexed; the former has the involucre of *B. Careyana* with appressed bracts. I doubt that *B. terebinthacea* is found east of northwestern Idaho.

It is a kind of puzzle to me, to determine what rule Professor Nelson followed in making these reductions. The specific name *terebinthacea* (1833) is much older than *macrophylla* (1841), and even where Nuttall transferred the former from *Heliopsis* to *Balsamorrhiza* it has page priority. If united, *B. terebinthacea* should be the species and *B. macrophylla* the variety.

Balsamorrhiza floccosa Rydb. and *B. tomentosa* Rydb. were reduced to synonyms of *B. incana* and *B. sagittata* respectively. It may be admitted that they (especially *B. tomentosa*) are closely related to the species to which they are referred, but I doubt if the authors of the New Manual have seen authentic material of either. In the Bulletin of the Torrey Botanical Club, November, 1900, I gave a synopsis of the Rocky Mountain species of this genus, and have not found any material change to make since that time.

Gymnolomia linearis sp. nov.

Perennial with a rootstock or slender caudex; stems 3–4 dm. high, terete, strigose; leaves opposite, short-petioled, narrowly linear, 3–4 cm. long, 2–4 mm. wide, entire, hirsutulous, indistinctly 3-nerved, sparingly hispid-ciliate at the base; heads long-peduncled; involucres about 6 mm. high, 12–15 mm. broad; bracts linear-lanceolate, canescent-strigose; rays 10–12 mm. long, 3–4 mm. wide.

This species resembles *Gymnolomia longifolia* and *G. annua* in leaf form and general habit, but it is a perennial. From *G. multiflora* it differs in the narrow leaves and the slender perennial base, which would be classified rather as a rootstock than a caudex. The type number was included in *G. multiflora* by Robinson and Greenman* as a narrow-leaved form. The other specimens cited by them as belonging to this form, I have not seen, but probably they should be included in *G. linearis*.

UTAH: St. George, 1877, *E. Palmer* 241 (type, in herb. Columbia Univ.).

*Proc. Boston Soc. Nat. Hist. 29: 92. 1899.

Gymnolomia ciliata (Robins. & Greenm.) Rydb. sp. nov.

Gymnolomia hispida, var. *ciliata* Robins. & Greenm. Proc. Boston Soc. Nat. Hist. **29**: 93. 1899.

HELIANTHUS

The authors of the New Manual have reduced *Helianthus aridus* Rydb. to a synonym of *H. petiolaris*. Although the forms of its leaves resemble those of that species, *H. aridus* is much more closely related to *H. lenticularis* (*H. annuus* of the Manual), which is indicated by the form of the bracts and the pubescence. If it should be reduced at all, it should be made a variety of *H. lenticularis*. It may even be a depauperate form of that species.

Helianthus giganteus is omitted, although unquestionable specimens have been collected in Colorado. (See my Flora of Colorado, page 372.)

HELIANTHELLA

In the New Manual *Helianthella uniflora* is described in the key as having a purple disk. In all specimens I have seen the disk-corollas are yellow. *H. Douglasii* is not included in the flora, although it has been collected in Montana by F. W. Anderson and Tweedy, in the Yellowstone Park by Tweedy, and south thereof in Wyoming by C. C. Curtis. (See also my Flora of Montana and the Yellowstone National Park.)

ENCELIOPSIS

Enceliopsis nutans (Eastwood) A. Nels., from Colorado and Eastern Utah, is omitted in the New Manual. This is strange, as Professor A. Nelson is the author of the name *Enceliopsis* as well as of the combination *E. nutans*.

BIDENS

Bidens bipinnata L. is included in Coulter & Nelson's New Manual. I have not seen any specimens from the Rocky Mountain region that could be referred to that species. *B. Bigelovii* is, however, found in Colorado. *Crandall 2726*, *Shear 4587*, *Clements 64* and *82*, all resemble so closely the Mexican Boundary Survey *no. 582* and *no. 582a*, from which *B. Bigelovii* was described, that there is no doubt about the identity. Duplicates of

these two numbers of the Boundary Survey are in both the herbarium of the Columbia University and that of the New York Botanical Garden. The structure of the marginal achenes distinguishes *B. Bigelovii* at once from *B. bipinnata*.

THELESPERMA

In the description of *Thelesperma ambiguum* in Coulter & Nelson's New Manual, we find the following: "bracts of the outer involucre 8, subulate-linear, almost equalling or half the length of the inner," etc. In Wright's specimens, from which *T. ambiguum* was described, the outer bracts are ovate or elliptic, scarcely one fourth as long as the inner involucre. What is described in the New Manual is evidently *T. intermedium* Rydb. When I described the latter, I had known it for about ten years and had never been able to make it agree with Dr. Gray's description of *T. ambiguum* in the Synoptical Flora. In the original publication of *Thelesperma ambiguum* no diagnosis is given, only a few characters distinguishing it from related species. In habit *T. ambiguum* resembles most *T. subnudum*, having the creeping rootstock of that species, the long naked peduncles, and the leaves found near the base of the stem only. The range is given as Montana to New Mexico and Texas. This was probably taken from the Synoptical Flora. The specimens on which Dr. Gray extended the range to Montana belong to *T. marginatum*, in many respects closely related to *T. ambiguum* but with discoid heads. *T. ambiguum*, as far as I know, is not found north of southern Colorado. *T. intermedium*, which is really described under the name of *T. ambiguum* in the New Manual, does not have a "creeping rootstock" (as Gray described *T. ambiguum*) but has a biennial or perennial taproot; and it has a leafy stem. As the authors of the New Manual did not at all consider the differences in the subterranean parts of *T. ambiguum* and *T. intermedium*, it was natural that they would not consider the same parts in *T. trifidum* and *T. tenue*, which resemble each other much more closely, and we find the latter as a synonym of the former. *Thelesperma marginatum* Rydb. is ignored altogether, although in my Flora of Montana four collections from that state are cited.

HYMENOPAPPUS

Professor Nelson divides this genus into two groups: one with stems leafy throughout, mostly corymbosely branched and with numerous heads; the other with stems leafy below, the leaves reduced upwards, few or wanting, heads not numerous. In the first group, he places *Hymenopappus tenuifolius* and *H. luteus*. The first of these two always has a leafy stem and many heads, but in *H. luteus* the stem is not more leafy than it often is in *H. filifolius* and *H. cinereus*, and as a rule has less numerous heads than either of them. In the key of the New Manual *H. scaposus* is distinguished from the rest by the following character: "stem scapose, less than 2 dm. high." These characters we often find in both *H. luteus* and *H. araneosus*.

Hymenopappus cinereus Rydb. and *H. ochroleucus* Greene are made synonyms of *H. araneosus*. I take the two first to be the same, but think that the last one should be kept distinct. It is characterized by the denser, more permanent tomentum, a tuft of dense matted white tomentum on the caudex, and achenes with silky and more appressed pubescence. This is characteristic of neither *H. cinereus* nor *H. ochroleucus*. *Hymenopappus parvulus* Greene is made a synonym of *H. scaposus*, but it has a smaller head, no matted white tomentum on the caudex and subcylindraceous corolla-throat. The last character would associate it with *H. macroglottis*, *H. lugens*, and *H. eriopodus*, but its corollas are scarcely more than half the size of those of the other species. *H. scaposus* is not found in the region, as limited in the New Manual.

Hymenopappus lugens Greene is to be added to the region, having been collected above Marysvale, Utah, July 21, 1905, *Rydberg & Carlton 7049*, and *H. eriopodus* A. Nels., found in Diamond Valley, May 19, 1902, *Goodding 880*, and at Springdale, May 14, 1894, *Jones 5261*. The last has much broader segments to the leaves than the type and resembles *H. tomentosus* in habit, but has the corolla of *H. eriopodus*. It may prove to be distinct.

OTHAKE

In describing *Polypteris maxima*, Dr. J. K. Small overlooked the fact that the original *Palafoxia Hookeriana* was based on Drummond's plant, which he referred to *Polypteris maxima*. Mr. Bush,

in reëstablishing Rafinesque's genus *Othake* did not notice this discrepancy and the name *Othake Hookerianum* has hitherto been applied to the wrong species. The synonymy of the two species is as follows:

OTHAKE HOOKERIANUM (T. & G.) Bush, Trans. Acad. Sci. St. Louis **14**: 177. 1904

Palafoxia texana Hook. Ic. Pl. *pl.* 148. 1837. Not *P. texana* DC. 1836.

Palafoxia Hookeriana T. & G. Fl. N. Am. **2**: 368. 1842.

Polypteris maxima Small, Fl. SW. U. S. 1288. 1903.

Othake maximum Bush, Trans. Acad. Sci. St. Louis **14**: 179. 1904.

Both Hooker's description of *Palafoxia* and Torrey and Gray's description of *P. Hookeriana* were based on Drummond's specimens, of which there is a duplicate in the Columbia herbarium, and this belongs to *Polypteris maxima* Small. Hooker's plate also illustrates the same thing. It was not strange that Dr. Small was led astray, for the true *O. Hookerianum* is a very rare plant and it was natural to think that the common plant which had been taken for it by Gray, Porter, Coulter, Greene, A. Nelson, myself, and others, should be regarded as *O. Hookerianum*. The latter species should be known as

Othake sphacelatum (Nutt.) Rydb. nom. nov.

Stevia sphacelata Nutt.; Torr. Ann. Lyc. N. Y. **2**: 214. 1827.

Palafoxia Hookeriana subradiata T. & G. Fl. **2**: 368. 1842.

Polypteris Hookeriana A. Gray, Proc. Am. Acad. **19**: 30, mainly.

Othake Hookerianum Bush, Trans. Acad. Sci. St. Louis **14**: 177, as to the description. 1904.

Bush gives as a doubtful synonym *Othake longifolium* Raf.,* but the description does not fit this plant. *O. longifolium* is compared with *O. tenuifolium* Raf., *i. e.*, *Othake callosum* (Nutt.) Bush, and said to be much smaller in every respect than that species. *O. sphacelatum* has about twice as large heads as *O. callosum*.

Torrey's description of Nuttall's *Stevia sphacelata* is rather poor and not ample enough to recognize any species by, but the type, collected by James, is in the old Torrey herbarium and it is un-

*New Fl. Am. **4**: 74. 1838.

mistakably the plant here considered. Being the only available and certain specific name of the plant, *sphacelatum* is therefore taken up.

Othake macrolepis sp. nov.

Annual; stem 3–4 dm. high, strigose-puberulent, and glandular on the upper parts, with ascending branches; leaves alternate, linear, indistinctly 1-ribbed, strigose-puberulent on both sides, 3–5 cm. long, 2–3 mm. wide, short-petioled; involucres obconic, 9–10 mm. high and about as wide; bracts 8–12, in two subequal series, linear-oblanceolate, abruptly acute, scabrous-hispidulous and slightly glandular, green, with scarious tips, and the inner with narrow scarious margins; rays none; disk-corollas rose-purple, 14–15 mm. long; limb 4–5 mm. long, with linear lobes; achenes linear-obpyramidal, 7 mm. long, 1 mm. thick at the apex, strigose-canescent, pappus-scales 6–8, lanceolate, caudate-acuminate 5–6 mm. long.

This species is most closely related to *O. roseum* Bush, but has much larger heads, flowers, and fruit, and the leaves have a less distinct midrib. In the type of *O. roseum* the disk-corollas are only about 12 mm. long. There is no full-grown fruit in the type sheet, but other specimens show that the achenes are only 4–5 mm. long and their pappus-scales 2–3 mm. long, acute rather than caudate.

COLORADO: Rule Creek, Bent Co., Aug. 17, 1909, *G. E. Osterhout 4097* (type, in herb. N. Y. Bot. Gard.).

PICRADENIOPSIS

In the New Manual, my genus *Platyschkuhria* is accepted, but *Picradeniopsis* Rydb., fully as distinct from *Bahia*, is retained in the latter genus. In *Picradeniopsis* and *Achyropappus* the foliage is impressed-punctate, and the leaves opposite, which is not the case in the other genera included by Gray in *Bahia*. *Bahia* is a shrubby plant of South America with white rays. Using Professor Nelson's generic key, *Picradeniopsis* would key into *Hymenoxys*. It stands nearest to that genus, which has been known under the name *Picradenia*, but differs in the free bracts. *Picradeniopsis* is amply distinct from the non-punctate and alternate-leaved *Bahia* but may have been included in *Achyropappus*. The annual habit and rayless heads of that genus seem to be distinction enough.

Picradeniopsis Woodhousii (A. Gray) Rydb. comb. nov.

Achyropappus Woodhousii A. Gray. Proc. Am. Acad. **6**: 546. 1865.
Schkuhria Woodhousii A. Gray, Proc. Am. Acad. **9**: 199. 1874.
Bahia Woodhousii A. Gray, Syn. Fl. **1**^{2}: 333. 1884.

Dr. Gray in the work last cited includes this species in the annual species of *Bahia.* The plant is, however, perennial with a creeping rootstock, and in habit so closely resembling *P. oppositifolia* that it is often hard to distinguish the two. The flowers are of a much lighter color in *P. Woodhousii*, the rays being ochroleucous or straw-colored, and the pappus-scales are much narrower, lance-subulate, and only slightly scarious-margined.

This should have been included in the New Manual, as the type was collected in northern New Mexico.

PLATYSCHKUHRIA

Platyschkuhria oblongifolia (A. Gray) Rydb. should have been included in Coulter & Nelson's New Manual. It has been collected in southwestern Colorado. See Gray's Synoptical Flora **1**^{2}: 332, and my Flora of Colorado 377.

Platyschkuhria desertorum (Jones) Rydb. comb. nov.

Bahia desertorum M. E. Jones, Zoe **2**: 249. 1891.

This species is a close ally to *P. integrifolia*, differing mainly in the acuminate bracts.

VILLANOVA

By an oversight *Bahia dissecta* (A. Gray) Britton (*B. chrysanthemoides* A. Gray) was retained in *Bahia* in my Flora of Colorado. It should have been restored to *Villanova.* As nobody seems to have used this generic name in connection with the earliest specific one, the plant should be known as:

Villanova dissecta (A. Gray) Rydb. comb. nov.

Amauria ? dissecta A. Gray, Mem. Am. Acad. **4**: 104. 1849.
Villanova chrysanthemoides A. Gray, Pl. Wright **2**: 96. 1853.
Bahia chrysanthemoides A. Gray, Proc. Am. Acad. **19**: 28. 1883.
Bahia dissecta Britton, Trans. N. Y. Acad. Sci. **8**: 68. 1889.

CHAENACTIS

Chaenactis achilleaefolia H. & A. and *C. pedicularia* Greene are both reduced in the New Manual, the former to a variety of *C. Douglasii*, the latter to a synonym of *C. alpina*. I think that both should be kept up as species. The characters separating the former from *C. Douglasii* are not so much the dwarf habit and reduced crowded segments of the leaves, for such conditions are found in the true *C. Douglasii*, as the permanent tomentum and the longer and acute pappus-scales. *C. alpina* is subscapose with peduncles 2–7 cm. long and its involucre is much shorter than the corollas. *C. pedicularia* has leafy although short stems, very short peduncles 1–2 cm. long, and involucral bracts, in the specimens seen, fully as long as the flowers. Apparently *C. pedicularia* is the same as *C. Douglasii*, var. *montana* M. E. Jones,* of which the author states that it has been confused with *C. alpina*, but at the same time points out several distinctions.

CHAMAECHAENACTIS

In reviewing Coulter & Nelson's New Manual, Dr. B. L. Robinson† stated: "No mention, for instance, is made of *Encelia nutans* Eastwood and *Chaenactis scaposa* Eastwood." This is not exactly true, for the latter is included in the New Manual. It was not strange, however, that Dr. Robinson should overlook the fact, for who would expect to find it under the name *Actinella carnosa* A. Nels.? I doubt if Professor Nelson has seen any specimens, for if he had I do not think he would have transferred it to *Actinella*. The description in the New Manual is a verbatim copy of Miss Eastwood's description. The plant is evidently more closely related to *Chaenactis*, in which genus it was first placed, than to *Actinella*. If Professor Nelson was unwilling to adopt my generic name *Chamaechaenactis*, it would have been much better to retain the species in *Chaenactis* than to transfer it to *Actinella*, where it is wholly out of place. Besides, *Chamaechaenactis* is fully as good as Nelson's own genera *Tonestus* and *Wyomingia*, and far more so than *Nacrea* and *Enomegra*. The last has no scientific standing at all, being distinguished from *Argemone* only by the

* Proc. California Acad. Sci. II. 5: 700. 1895.
†Rhodora 12: 16. 1910.

yellow instead of milky white sap. In which genus should a species with ochroleucous or white sap, turning yellowish, be placed?

Correction

The California specimens referred to *Scutellaria veronicifolia* in a previous installment of the studies belong to *S. californica* A. Gray, and not to the former, having a different corolla.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1909)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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Includes new species of *Calea*, *Zexmenia*, and *Isostigma*.

Hassler, E. Ex herbario Hassleriano: Novitates paraguarienses. II. Repert. Nov. Spec. **7**: 69–78. 20 Ap 1909.

Includes 5 separate articles by A. Cogniaux (3), and E. Hassler (2), here indexed under their respective authors.

Hassler, E. Ex herbario Hassleriano: Novitates paraguarienses. III. Repert. Nov. Spec. **7**: 369–383. 15 D 1909.

Includes 3 separate articles by E. Hackel, H. Christ, and E. Hassler, here indexed under their respective authors.

Hassler, E. *Rosaceae* [In Hassler, Ex herbario Hassleriano: Novitates paraguarienses. III.] Repert. Nov. Spec. **7**: 375, 376. 15 D 1909.

Includes *Couepia paraguariensis* sp. nov.

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Vol. 37 No. 7

BULLETIN

OF THE

TORREY BOTANICAL CLUB

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Studies of West Indian plants — III

NATHANIEL LORD BRITTON

12. THE WEST INDIAN SPECIES OF COMOCLADIA P. BR.

COMOCLADIA* P. Br.; L. Syst. ed. 10, 861. 1759

Type species: *Comocladia pinnatifida* L.

1. Leaves entire or undulate.
   A. Glabrous species.
      a. Lateral leaflets distinctly stalked.

1. COMOCLADIA PINNATIFIDA L. Syst. ed. 10, 861. 1759

Comocladia integrifolia Jacq. Enum. Pl. Carib. 12. 1760.

TYPE LOCALITY: Jamaica.

Both names are based wholly on P. Browne, Hist. Jam. 124, where the generic name is printed *Comocladia*. Browne refers to Sloane's description and figure of "Prunus racemosa, caudice non ramosa" (Hist. Jam. 2: 131. *pl. 222. f. 1*); the illustration there given is not wholly satisfactory for the plant which has been taken for this species, but which is here accepted as usually interpreted.

DISTRIBUTION: Moist woodlands at middle and lower elevations throughout Jamaica; Haiti and Santo Domingo.

*The spelling of the generic name was changed by Linnaeus to *Camocladia*, but this form is here regarded as a typographical error, although it was continued by Linnaeus, in the second edition of Species Plantarum, and in successive editions of the Systema, but was changed back to the original by Gmelin (Syst. ed. 13. 1791). The original spelling was accepted by Jacquin, by Swartz, and by most subsequent authors.

[The BULLETIN for June, 1910 (37 : 273–344. *pl. 33*), was issued 21 Jl 1910.]

2. **Comocladia Hollickii** sp. nov.

Low, flowering when not more than 1 m. high, the tallest plants seen not more than 3 m. high. Leaves 3–4 dm. long, glabrous; leaflets 17–21, distinctly petioluled, subcoriaceous in texture, undulate-dentate with acutish teeth, acuminate at the apex, obtuse or truncate at the base; lower leaflets ovate, 3–5 cm. long, middle leaflets (5 or 6 pairs) ovate-lanceolate to oblong, 6–9 cm. long, terminal leaflet broadly lanceolate, long-petioluled, 6–8 cm. long; petiolules of the lateral leaflets 1.5–3 mm. long; petioles 3–6 cm. long; inflorescence glabrous, short, about 8 cm. long, sparingly branched, narrow; pedicels 1 mm. long or less; corolla-buds 0.5 mm. in diameter, purple; sepals and petals obtuse, rounded; filaments twice as long as the anthers.

Rocky hillside, Bluefields Mountain, Jamaica, at 500 m. altitude (*Britton & Hollick 2000*, March, 1908, type); wooded hill, Potsdam, Santa Cruz Mountains, Jamaica (*Britton 1271*).

3. **Comocladia grandidentata** sp. nov.

A slender tree, up to 10 m. high. Leaves glabrous, about 8 dm. long; leaflets about 29, petioluled, thin in texture, coarsely irregularly dentate with obtuse or acutish teeth, acute or abruptly acuminate at the apex, obtuse or subtruncate and more or less oblique at the base, the lower 4 or 5 pairs ovate, 3 5–6 cm. long, the others oblong, oblong-lanceolate or somewhat oblong-oblanceolate, 7–11 cm. long, 2.5–4 cm. wide; lateral petiolules 2–3 mm. long; flowers and fruit unknown.

Hopeton, Westmoreland (*Harris 9944*, Sept. 19, 1907).

4. COMOCLADIA EHRENBERGII Engler, Bot. Jahrb. **1**: 420. 1881

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Santo Domingo.

Note.—Known to me only from the description. A glabrous species, its leaves with only two pairs of entire ovate short-petioluled leaflets.

b. **Lateral leaflets sessile or subsessile.**

5. **Comocladia parvifoliola** sp. nov.

A tree, up to 10 meters high, glabrous throughout. Leaves 1–2 dm. long; leaflets 7–11, coriaceous, entire, sessile, or on petiolules 1 mm. long or less, rounded or subcordate at the base, acute or bluntly short-acuminate at the apex, the lowest pair ovate,

2–4 cm. long, the others oblong or oblong-lanceolate, 4–7 cm. long; panicles very slender, as long as the leaves or longer; flowers minute; sepals broadly ovate, obtuse; petals twice as long as the sepals, oval-orbicular, rounded; stamens a little shorter than the petals.

Woodlands, Dolphin Head Mountain, Jamaica (*Britton 2473*, March, 1908, type; *Harris 10,267*).

6. COMOCLADIA CORDATA N. L. Britton, Torreya 7: 6. 1907

TYPE LOCALITY: Troy, Jamaica.

DISTRIBUTION: Known only from the type locality.

B. Pubescent species.

a. Lateral leaflets distinctly stalked.

7. COMOCLADIA PUBESCENS Engler, Bot. Jahrb. 1: 420. 1881

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Jamaica, in woodlands at lower and middle elevations in relatively moist districts.

8. **Comocladia jamaicensis** sp. nov.

Low, about 2 meters high. Leaves 3–4.5 dm. long, the rachis loosely pilose; leaflets about 21, thin in texture, distinctly petioluled, obtuse or subtruncate at the base, acute to acuminate at the apex, glabrous above, sparingly pubescent on the veins beneath, undulate-dentate or some of them nearly entire; lateral petiolules 2–3 mm. long; lower two or three pairs of leaflets ovate, 3–5 cm. long, the others lanceolate, ovate-lanceolate or oblong, 5–10 cm. long, 1.5–4 cm. wide; inflorescence puberulent, shorter than the leaves, about 3 dm. long, its branches short and slender; sepals and petals obtuse; young stamens with filaments not longer than the anthers.

On dry rocky hill, Green Island, Jamaica (*Britton & Hollick 2132*, March, 1908, type; *Harris 10,250*).

b. Lateral leaflets sessile or subsessile.

9. COMOCLADIA VELUTINA N. L. Britton, Torreya 7: 6. 1907

TYPE LOCALITY: Great Goat Island, Jamaica.

DISTRIBUTION: Jamaica, on very dry rocky hillsides and sand dunes near the southern coast, Healthshire Hills to Great Pedro Bay.

Note.—Recorded by Grisebach from Jamaica as *C. propinqua*, which it little resembles.

10. **Comocladia pilosa** sp. nov.

A tree, 6 meters high, the young twigs, leaves, and inflorescence densely pilose-pubescent. Leaves about 7 dm. long; leaflets about 19, chartaceous, dark green above, paler beneath, entire-margined, the lateral ones sessile, or on petiolules about 1 mm. long, cordate or subtruncate at the base, obtuse, acutish or abruptly short-acuminate at the apex; lowest pair of leaflets suborbicular, 4–5 cm. long; second and third pairs ovate-orbicular, 5–8 cm. long, the others oblong or ovate-oblong, 9–14 cm. long, 4–5 cm. wide; terminal leaflet long-stalked; panicles several, shorter than the leaves, 2.5 dm. long or less, the branches rather stout; calyx with a few scattered hairs, the sepals rounded; petals a little longer than the sepals, rounded; filaments twice as long as the anthers.

Wooded hill, Union Hill, near Moneague, Parish of St. Ann's, Jamaica (*Britton & Hollick 2762*, April, 1908).

11. COMOCLADIA UNDULATA Urban, Symb. Ant. **5**: 401. 1908

TYPE LOCALITY: Martinique.

DISTRIBUTION: Known only from Martinique.

2. Teeth of the leaves bristle-tipped.

A. Glabrous species.

12. COMOCLADIA PLATYPHYLLA A. Rich.; Griseb. Cat. Pl. Cub. 68. 1866

TYPE LOCALITY: Cuba [*Rugel 277*, the type specimen, is from Matanzas].

DISTRIBUTION: Cuba, at lower altitudes, provinces of Oriente, Camagüey, Santa Clara, Matanzas, and Havana.

Note.—Lower leaflets ovate, the others mostly oblong. Engler (DC. Mon. Phan. **6**: 365) describes a specimen with all the leaflets ovate, long-stalked, and with only 3 or 4 teeth on each margin. The number of teeth is often 9 on each margin. The species consists of a number of races, differing in width of leaflets, length of petiolules and number of teeth on the leaf-margins, the extremes appearing quite different from each other.

A. Richard (in Sagra, Hist. Cub. **10**: 155. 1850) remarks

as follows concerning this species, which was subsequently described by Grisebach:

"I have observed an example of this tree, but without flowers, which, it seems to me, could form, if not a distinct species, which I am not far from believing, at least a very notable variety. The leaflets are almost as large as the leaves of the 'castaño,' are also rough on both faces, dentate and spine-like in their contour; and, in short, recall in all their shape the leaflets of *Comocladia dentata*, but are much larger and rougher. If the opportunity comes to see this plant with flower and fruit it will perhaps be possible to form a distinct species to which the name *Comocladia platyphila** will apply perfectly."

13. COMOCLADIA INTERMEDIA C. Wright; Engler in DC. Mon. Phan. **4**: 366. 1883

TYPE LOCALITY: Cuba. [Wright's specimen in the Kew Herbarium is from Trinidad, Cuba.]

DISTRIBUTION: Southern coast of Santa Clara Province, Cuba, in dry districts.

14. **Comocladia acuminata** sp. nov.

Leaves about 1 m. long, glabrous. Leaflets about 31, chartaceous, short-petioluled, the lowest ovate to ovate-lanceolate, 5–6 cm. long, the others oblong-lanceolate, 10–14 cm. long, 3–4 cm. wide; slenderly acuminate at the apex, broadly cuneate at the base, serrate with about 8 bristle-tipped teeth on each margin, the veins prominent on the underside, diverging nearly at right angles from the slender midvein, the under surface paler green than the upper; panicles 4 dm. long, glabrous, slender, their branches widely diverging, 8–12 cm. long; flowers 4-parted, about 1.5 mm. broad.

Santo Domingo (*Wright, Parry & Brummel 192*, in United States National Herbarium).

B. Pubescent species.

15. COMOCLADIA GLABRA Spreng. Syst. **1**: 176. 1825

TYPE LOCALITY: Porto Rico.

DISTRIBUTION: Porto Rico, at lower and middle elevations

*Doubtless a misprint for *platyphylla*.

in moist and wet districts. Recorded by Engler from Santo Domingo and from Cuba.

The inflorescence, leaf-rachis, and venation of this species are sparingly pubescent. The races differ greatly in the length of the spiny tips of the teeth of the leaflets.

16. COMOCLADIA DENTATA Jacq. Enum. Pl. Carib. 12. 1760

Comocladia propinqua H. B. K. Nov. Gen. **7**: 16. 1824.

Comocladia dentata propinqua Engler, in DC. Mon. Phan. **4**: 364. 1883.

TYPE LOCALITY: Near Havana, Cuba (according to Jacq. Stirp. Am. 13. *pl.* 173).

DISTRIBUTION: Woodlands at lower elevations, provinces of Camagüey, Havana, Matanzas, and Santa Clara, Cuba, ascending to 420 meters on the Trinidad Mountains; Santo Domingo.

Field observations indicate that *Comocladia dentata* and *C. propinqua* can not be held as distinct species; the leaflets vary from narrowly lanceolate to broadly ovate, and from sharply spinulose-dentate to nearly or quite entire. The tree becomes 6 meters high in Santa Clara, Cuba.

Note.—Comocladia dentata brevifolia Engler, in DC. Mon. Phan. **4**: 364. 1883.

I have not seen this plant, described as from "Domingo" it may be the same as the following species.

17. **Comocladia domingensis** sp. nov.

Twigs densely short-pubescent. Leaves about 2 dm. long, the rachis densely short-pilose; leaflets 17–19, ovate to ovate-elliptic, sessile, chartaceous, obtuse at the apex, rounded or subtruncate at the base, glabrous and rather dark green above, pilose on the prominent veins and light green beneath, the lower ones 1.5–2.5 cm. long, the others 4–5 cm. long, 2–3 cm. wide, serrate with 7 or 8 spinulose-tipped teeth on each margin and spinulose at the apex; panicles narrow, slender, loosely pilose, about 13 cm. long; flowers 4-parted; sepals orbicular, 0.5 mm. long; petals ovate, obtuse, 1 mm. long; stamens much shorter than the petals.

Santo Domingo (*Wright, Parry & Brummell 190*, in United States National Herbarium).

18. **Comocladia Dodonaea** (L.)

Ilex Dodonaea L., Sp. Pl. 125. 1753.

Comocladia tricuspidata Lam. Mém. Acad. Sci. Paris **1784**: 347. 1787.

Comocladia ilicifolia Sw. Prodr. 17. 1788.

TYPE LOCALITY: "America meridionalis."

Plumier's *plate 118, f. 1*, identifies this species beyond doubt.

DISTRIBUTION: Santo Domingo (according to Engler); Porto Rico, at low elevations in dry districts; Culebra; St. Thomas; St. Croix; Montserrat; Antigua; Guadeloupe; Mustique Island, Grenadines.

Note.—This species is the monotype of the genus *Dodonaea* (Plum.) Adans. 1763.

13. THE GENUS VIBURNUM IN JAMAICA

1. VIBURNUM VILLOSUM Sw. Prodr. 54. 1788

Hillsides and woodlands in moist and wet districts, at middle and higher altitudes, ascending to 2300 meters in the Blue Mountains.

The species apparently consists of numerous races, differing in the amount of stellate pubescence, in the shape of the fruit, and in the length of the stamens. Very densely tomentose bushes grow in proximity to slightly pubescent ones about Cinchona.

2. **Viburnum arboreum** sp. nov.

A tree, 15 m. high, with a straight trunk and spreading branches. Leaves chartaceous, entire, oval-elliptic, dull green, glabrous or sparingly stellate-pubescent above, loosely stellate-pubescent beneath, 8–12 cm. long, 5–6.5 cm. wide, short-acuminate at the apex, unequally narrowed or obtuse at the base, the veins about 6 on each side of the midvein, the stout petioles stellate-pubescent, 1–2 cm. long, inflorescence stellate-pubescent, 8–12 cm. broad; fruiting pedicels 3 mm. long or less; fruit oblong, 9–10 mm. long and 3 mm. thick when dry, narrowed at both ends, crowned by the ovate acute ciliate calyx-lobes and tipped by the base of the style.

Wooded rocky hill, Tyre, Cockpit Country (*Britton*, Sept. 13–18, 1906, *no.* 553, *type; Harris 9475*). *Harris 9403* from the same region, a shrub with white flowers, is probably this species.

3. VIBURNUM ALPINUM Macf. Fl. Jam. 2: 201. 1850

Hillsides and woodlands at middle and higher elevations in both relatively dry and wet districts, ascending to at least 1800 meters in the Blue Mountains. Erroneously regarded by Grisebach as identical with *V. glabratum* H.B.K. of Mexico and South America.

14. HITHERTO UNDESCRIBED SPECIES OF JAMAICA

Thrinax Rex Britton & Harris, sp. nov.

Trunk up to 20 meters high, cylindric, 2–2.5 dm. in diameter, sometimes swollen at the base. Leaf-blades of middle-sized trees 3 m. broad, silvery beneath, those of young plants sometimes 4 m. broad; leaf-segments 40–50, united to about one half, 3–5 cm. wide, notched at the apex into rigid acuminate narrow lobes 1–3 cm. long, revolute-margined, the midrib prominent on the under side; petioles very stout, compressed, 2-edged, as long as the blades or longer; ligule triangular, acute, 2–2.5 cm. long; inflorescence glabrous, much shorter than the leaves; bracts oblong, puberulent, with a triangular-acute apex; ultimate branches of the inflorescence rather stout, 10–12 cm. long; pedicels stout, 1.5–2 mm. long, about twice as long as the triangular acuminate bractlets; calyx hemispheric-campanulate, minutely toothed; fruit subglobose, 6–7 mm. in diameter; seeds brown, globular, shining, very nearly smooth, 5 mm. in diameter.

Eastern slopes of the John Crow Mountains at 450 to 600 meters altitude (*Britton 4151; Harris & Britton 10,759*).

Chamaecrista fasciata sp. nov.

Herbaceous, the roots apparently annual, the stems slender, erect, little-branched, 5–10 dm. high, more or less pubescent with long curled hairs. Leaves 8 cm. long or less, short-petioled; leaflets 20–40, linear-lanceolate, inequilateral, rounded at the base, acute and aristulate at the apex, strongly veined, ciliolate, but otherwise nearly glabrous, 10–12 mm. long, 1.5–2 mm. wide; stipules lanceolate-attenuate, strongly veined, 8–10 mm. long; gland scutellate, sessile, 0.5 mm. wide, borne on the petiole below the lowest pair of leaflets; peduncles a little shorter than the petioles, villous, the bracts ovate-acuminate, about 4 mm. long; sepals lanceolate, acuminate, villous on the back, about one half as long as the petals; flowers 1.5 cm. broad; ovary and young pod densely long-villous; mature pod linear, a little curved, some-

what narrowed toward the base, 4–5 cm. long, 5–6 mm. wide, obliquely short-beaked, loosely villous, black-banded over the spaces between the seeds and along both margins.

Bank, between Bath and Cuna-Cuna Gap, at 300 m. altitude (*Britton 3500*, September, 1908).

Meibomia umbrosa sp. nov.

Stem trailing, sometimes 1 m. long, densely villous to the base. Leaflets ovate to ovate-lanceolate, 6–10 cm. long, acute or acuminate at the apex, the lateral ones short-stalked, obliquely obtuse at the base, the middle one narrowed or blunt at the base and longer-stalked, all finely and rather densely pubescent beneath, sparingly pubescent above; petioles about as long as the leaflets, densely villous; stipules lance-subulate, about 1 cm. long; peduncles arising in the lower axils, as long as the leaves or longer, slender, pubescent, bearing a few distant lance-subulate bracts; flowers purple; fruiting racemes 1 dm. long or longer, the filiform pedicels spreading, about 2 cm. long; loment 1–3-jointed, the upper suture undulate; loment-joints obliquely oblong, nearly separated, uncinate, about 8 mm. long and 5 mm. high.

Shaded grassy hillside, Troy, Jamaica (*Britton 444*, Sept. 13–18, 1906, type); woodlands near Newport, Manchester (*Britton 3209*); nearest to *M. axillaris* (Sw.) Kuntze, which is nearly glabrous, with blunt leaflets.

Cissus (?) **cucurbitacea** Britton, sp. nov.

A woody, high-climbing vine, the stem up to 7.5 cm. thick at the base, the twigs and leaves fleshy. Leaves triangular-ovate, 6–10 cm. long, cordate at the base with a widely open sinus, 5-nerved and pinnately veined, remotely dentate with apiculate teeth, scabrous on both sides with short stiff hairs or when old papillose, the petioles 2–3 cm. long; tendrils slender, 1–2 dm. long.

Dry rocky hillside, Fort Henderson, Jamaica (*Britton & Hollick 1812*, March 2, 1908, type); base of Healthshire Hills (*Harris & Britton 10,512*).

An interesting xerophytic vine, of which we do not yet know either flowers or fruit.

Xylophylla contorta sp. nov.

A much branched shrub about 1 m. high, the main branches terete, the twigs flat and 2-edged. Phyllodes pale green, linear,

5–7 mm. wide at the middle, 6–10 cm. long, narrowed to both ends, acutish, many of them curved or falcate, finely and closely striate, the upper ones floriferous to below the middle, the crenatures 1-flowered, distant; stipules triangular-lanceolate, 2 mm. long or less; pedicels of pistillate flowers 3.5–4.5 mm. long, very slender, thickened above, sepals broadly ovate, obtusish, about 1 mm. long; fruit depressed, 3-lobed, obscurely reticulated, 3.5 mm. wide, nearly 2 mm. high; seed obovoid, 1.5 mm. long, minutely black-dotted.

Dry hillside, St. Ann's Bay (*Britton 2515*, March, 1908).

Tricera macrophylla sp. nov.

An erect virgate simple or sparingly branched shrub 1–2 meters high, with rough bark. Leaves narrowly elliptic or lanceolate-elliptic, very large for the genus, flat, 15–24 cm. long, 5–8 cm. wide, subcoriaceous, acute at both ends, the midvein stout, prominent beneath, impressed above, the veins numerous, slender, diverging nearly at right angles from the midvein and connected at 2–3 mm. from the margin, the ultimate venation finely and strongly reticulated, the stout petiole 1–1.5 cm. long; capsules brown, finely pubescent, 7–8 mm. long, woody, their recurved beaks 2 mm. long; inflorescence very short-stalked, lateral and supra-axillary; seeds linear-oblong, shining, 5 mm. long.

Woodlands, eastern and southeastern slopes of the John Crow Mountains at 500 meters altitude (*Harris & Britton 10,770*, March 11, 1909, type; *Britton 4173, 4193*).

Clusia silvicola sp. nov.

A tree, 12 m. high. Leaves firm, obovate, 13 cm. long, 7–8 cm. wide, firm, thick, dull, inconspicuously veined, rounded at the apex, cuneate-narrowed at the base, the midvein rather prominent beneath, the stout petiole 1 cm. long; fruit ovoid, white, 7 cm. long, about 5 cm. thick; sepals 4, broad; bracts much smaller than the sepals; stigmas 8, sessile, oblong-obovate, 8 mm. long, 4–5 mm. wide, with a slight depression near the base.

Wooded hill near Dolphin Head, Hanover, 400 m. altitude (*Britton 2330*, March 18–20, 1908).

Homalium integrifolium sp. nov.

A tree, about 15 m. high, the foliage glabrous. Leaves oblong-lanceolate, 10–15 cm. long, 4 or 5 cm. wide, entire-margined or with a few low crenatures, chartaceous, attenuate-acuminate at

the apex, obtuse or somewhat narrowed at the base, the midvein impressed above, rather prominent beneath, the primary veins about 12 on each side, the ultimate venation reticulated; petioles 6–8 mm. long; raceme 8–10 cm. long, its axis puberulent; pedicels 2–4 mm. long; hypanthium, sepals, and petals puberulent; sepals linear, acutish, 2.5 mm. long; petals ovate with a bluntish point, nearly 3 mm. long; stamens numerous; glands of the disk nearly contiguous; ovary depressed-globose.

Woodlands, eastern slopes of the southern end of the John Crow Mountains (*Harris & Britton 10,741*, March 10, 1909).

Anamomis grandis sp. nov.

A tree up to 13 meters high, the bark smooth, reddish, the branches gray, the young twigs sparingly pubescent. Leaves thin in texture, the blades pale green on both sides, not shining, copiously punctate, rather prominently veined, obovate, 4–6 cm. long, 2–4 cm. wide, obtuse or sometimes emarginate at the apex, narrowed or cuneate at the base, the midvein sparingly pubescent, impressed above, rather prominent beneath, the pubescent petioles 7–10 mm. long; peduncles slender, pubescent, 3–4 cm. long; cyme 3-flowered, the central flower sessile, the lateral ones on pubescent diverging pedicels 6 mm. long; hypanthium subglobose, appressed-pubescent; sepals concave, 2.5 mm. broad, rather broader than long, punctate, ciliate.

Dry rocky woodlands, Great Goat Island (*Harris 9307*).

Differs from *A. fragrans* (Sw.) Willd., of the Jamaica mountains, which has coriaceous, elliptic, shining, short-petioled leaves, and nearly erect pedicels.

Petesioides subverticillatum sp. nov.

A woodland shrub, 1–2 m. high, with slender branches. Leaves subopposite or subverticillate, sessile, oblong-elliptic to ovate-oblong, 5–14 cm. long, 6 cm. wide or less, cordate-clasping at the base with rounded auricles, acute or obtusish at the apex, indistinctly pinnately veined and slightly reticulated, punctate, the margins low-crenulate or entire; inflorescence bipinnate-paniculate, terminal, 4–6 cm. wide; pedicels rather stout, 1.5–3 mm. long; flowers 4-merous; calyx and corolla epunctate; staminate calyx 2.5 mm. long, its lobes semiorbicular-ovate, rounded, about one third as long as the tube; corolla as long as the calyx and similarly lobed; stamens nearly twice as long as the corolla; pistillate calyx 1 mm. long, the corolla a little shorter; staminodia half as long as the corolla; ovary ovoid; style short and stout;

fruit subglobose, red, 2.5 mm. in diameter, apiculate with the base of the style.

Woodlands, southeastern slopes of the John Crow Mountains, 350–600 m. altitude (*Harris & Britton 10,694*, type; *Britton 3937; Harris & Britton 10,701*); slopes, Cuna-Cuna Gap, *Britton 4049*)

Plumiera jamaicensis sp. nov.

An irregularly branched tree 8–10 m. high, the trunk up to 3 dm. in diameter. Leaves firm in texture, the blade elliptic, 12–15 cm. long, 5–7 cm. wide, rounded or emarginate at the apex, narrowed at the base, glabrous on both sides, or minutely puberulent on the veins beneath, the upper surface dark green with the veins somewhat impressed, the under surface lighter green with the broad nerves very prominent, diverging nearly at right angles from the strong elevated midvein, the ultimate venation strongly reticulated; petiole stout, 3–4.5 cm. long; peduncle stout, 18 cm. long or less; flowers numerous; bracts broadly ovate, acutish, 1.5 mm. long; pedicels 8–13 mm. long; calyx nearly truncate, with 5 short teeth; corolla white with a yellowish blotch at the base of each lobe, the tube 1 cm. long, the lobes 2–2.5 cm. long, oblong-obovate, obtuse; pods 15–22 cm. long, 1.5–2 cm. in diameter.

Coastal hillsides and thickets, parish of Portland. Wheelerfield, March 13, 1909 (*Britton 4123*, type); near Port Antonio, Sept. 25, 1906 (*Britton 870*). Near *P. emarginata* Griseb., of Cuba.

Valerianoides jamaicensis × mutabilis.

Hybrids are not often seen in the West Indian flora, but the one here recorded seems to be genuine. I found it growing near its parents on a roadside between Mandeville and Brown's Town, Manchester, with characters of foliage and flowers exactly intermediate.

Lantana jamaicensis sp. nov.

A vine, climbing on trees, up to 7 meters long, or shrubby and 1 meter high, or less, the branches long, slender, terete, densely puberulent. Leaves lanceolate to ovate, 2.5–9 cm. long, rather firm in texture, acute or acuminate at the apex, narrowed or rounded at the base, crenulate, sparingly pubescent above, densely puberulent and rather prominently veined beneath, or becoming glabrate, the petioles 1 cm. long or less; peduncles puberulent, 2–4 cm. long; heads involucrate, subglobose in flower, 1–1.5 cm.

in diameter, somewhat elongating in fruit; involucral bracts ovate to lanceolate, acutish, puberulent; corolla 6.5–10 mm. long, white or pale pink with a yellowish eye, puberulent, its lobes irregularly rounded; calyx-limb undulate, ciliate; stamens borne near the middle of the corolla-tube.

Banks and woodlands, Manchester and St. Elizabeth. Type from between Malvern and Stanmore Hill, Santa Cruz Mountains (*Britton 1097*, Sept. 3, 1907).

Apparently recorded by Grisebach as *Lantana stricta lilacina*, but it is not *Lantana lilacina* of South America. Certainly distinct from *Lantana stricta*.

Lantana arida sp. nov.

A widely branched shrub 1 meter high, or less, pubescent with long simple hairs and short glandular hairs intermixed; branches slender, 4-angled. Leaves ovate to oval, 1–2 cm. long, obtuse at both ends, or acutish at the apex, densely pubescent on both sides, rather firm in texture, crenate-dentate, the venation impressed above, prominent beneath, about 4 veins on each side of the midvein; petioles 2–3 mm. long; peduncles slender, longer than the leaves; inflorescence capitate; fruit oblong, 3–4 mm. long.

Dry rocky hillside, Salt Pond Hills, Kingston Harbor, in old fruit March 2, 1908 (*Britton & Hollick 1824*).

Rondeletia elegans sp. nov.

A tree, 5 m. high, the twigs densely appressed-pubescent. Leaves rather firm in texture, elliptic, the blades 11–16 cm. long, 9 cm. wide or less, glabrous above, sparingly pubescent on the veins beneath when old, quite densely pubescent beneath when young, acuminate at the apex, narrowed at the base, the midvein prominent beneath, with about 7 veins on each side, the stout pubescent petioles 2–4 cm. long; cymes axillary, pubescent, the peduncles about as long as the petioles; flowers all pedicelled; hypanthium hemispheric, pubescent, 1.5 cm. long; sepals narrowly lanceolate, pubescent, about as long as the hypanthium; corolla salverform, 10–14 mm. long, the cylindric crimson tube about twice as long as the 5 tawny-yellow obovate-orbicular undulate lobes; stamens sessile near the top of the corolla-tube; style 3 mm. long, pubescent below; fruit about 7 mm. long.

Woodlands, eastern slopes of the John Crow Mountains at 520 m. altitude (*Britton 4143*, March, 1909, type; *Harris & Britton 10,744*).

Rondeletia pallida sp. nov.

A tree, 10 m. high, the young foliage sparingly pubescent. Leaves thin, bright green, oblong-lanceolate to elliptic, 18 cm. long or less, 2–7 cm. wide, glabrous or with a few scattered hairs beneath and on the slender petioles when old, sharply acuminate at the apex, cuneate-narrowed at the base, the narrow midrib rather prominent on both sides with 4 or 5 pairs of veins on each side, the petioles 1–2 cm. long; cymes axillary; peduncles slender, a little shorter than the petioles; bractlets linear-lanceolate, pubescent, 2–3 mm. long; flowers in threes on the branches of the cyme, all on slender glabrous pedicels 3–5 mm. long; hypanthium hemispheric-campanulate, 1.5–2 mm. high; sepals triangular-lanceolate, acuminate, nearly as long as the hypanthium; corolla white or yellowish, fading brownish, 12–15 mm. long, salverform, glabrous or puberulent, the cylindric tube twice to three times as long as the 5 suborbicular, rounded, spreading lobes; stamens borne near the top of the corolla-tube, the filaments shorter than the anthers; style about 3 mm. long, pubescent below; stigma 2-lobed; fruit about 6 mm. long.

Woodlands, southeastern foothills of the John Crow Mountains, 350 m. altitude (*Britton 3992*, March, 1909, type; *3940; 4146; Harris & Britton, 10,680, 10,724*).

Guettarda constricta sp. nov.

A tree about 7 m. high, the twigs terete. Leaves broadly ovate; blades 17 cm. long or less, about two thirds as wide as long, rather firm in texture, glabrous and bright green above or puberulent on the veins, pale green or whitish and densely puberulent beneath, short-acuminate at the apex, obtuse or subtruncate and sometimes strongly inequilateral at the base, with 8 or 9 pairs of veins on each side of the prominent midvein; petioles stout, puberulent, 6 cm. long or less; peduncles axillary, somewhat angled, puberulent, as long as the petioles or longer; cymes several-flowered; fruit sessile, oval, finely puberulent, 10–12 mm. long, 8 or 9 mm. thick, obtuse at the apex, narrowed at the unequal base, distinctly constricted at the middle.

Wooded hillside, Grove Place,. Manchester (*Britton 3769*, September, 1908). The fruit of *G. argentea* is globular.

Psychotria subcordata sp. nov.

A slender tree, 5 m. tall, the twigs and leaves glabrous. Leaves lanceolate to oblong-lanceolate, thin in texture, 7–10 cm. long,

2.5–3.5 cm. wide, sessile, subcordate at the base, acuminate at the apex, dark green above, paler beneath, the midvein rather prominent on both sides, the veins about 10 on each side of the midvein, diverging from it nearly at right angles, curving upward and united 2 or 3 mm. from the margins; stipules apparently distinct, deciduous; cyme sessile, 3-rayed, the rays slender, glabrous, 2.5–3 cm. long, the 2 or 3 raylets 1–1.5 cm. long; fruiting pedicels 2–5 mm. long; fruit globose-oblong, red, nearly 1 cm. long; pyrenae oblong, 8 mm. long, 4 mm. wide, strongly 3-crested longitudinally, with two shallow grooves on the nearly flat commissural side.

Woodlands, eastern slopes of the John Crow Mountains at 520 m. altitude (*Britton 4144*). Related to the Cuban *P. auriculata* C. Wright.

Lobelia grandifolia sp. nov.

Stem stout, somewhat pubescent, about 9 dm. high. Leaves flaccid, large, about 3 dm. long, 10–12 cm. wide, abruptly acuminate at the apex, cuneate at the base, crenulate all around, glabrous and dull green above, rather bright green beneath and pubescent on the veins, the broad flat midvein prominent, the numerous lateral veins arching upward; peduncles stout, pubescent, about 1.5 dm. long; raceme densely many-flowered, 1–1.5 dm. long; bracts linear-lanceolate, acuminate, glandular-serrate, nearly as long as the pedicels; pedicels about 2 cm. long; hypanthium campanulate, glabrous, 1 cm. long; sepals linear-lanceolate, glandular-serrate, 12–15 mm. long, 2 mm. wide; corolla yellowish white, greenish yellow, or brownish, glabrous, strongly curved, about 2.5 cm. long; andrœcium stout, pubescent, 1.5–2 cm. long; anthers 9 mm. long, loosely pubescent, two of them bearded at the tip.

Woodlands, eastern slopes of the John Crow Mountains at about 400 meters elevation (*Britton 4194*, type; *4197*; *Harris & Britton 10,725*). Related to *L. Fawcettii* Urban, in which the leaf-blade is decurrent on the petiole nearly or quite to the base, the sepals narrower and longer, the foliage glabrous or very nearly so.

Bidens Shrevei sp. nov.

Glabrous; stems woody, diffusely branched, reclining or straggling, 3–6 dm. long, the twigs striate. Leaves simple, ovate to lanceolate, 5–10 cm. long, acuminate at the apex, obtuse or subtruncate at the base, sharply serrulate, the slender petioles

one third to one half as long as the blades, the finely reticulate venation much darker in color than the parenchyma; heads several or numerous; peduncles 6 cm. long or less; involucre oblong-cylindric, about 1 cm. high, its bracts linear, spreading at anthesis, acutish and puberulent at the apex; rays oval to oblong, bluntish or emarginate, 1.5–2 cm. long, strongly veined; disk-corollas tubular-cylindric, narrowed below, 7–10 mm. long, with acute triangular-ovate teeth; anthers and style-branches slightly exserted; achenes linear, 12–16 mm. long, about 1 mm. thick, sparingly pubescent on the angles, the two yellowish awns 3–5 mm. long, downwardly barbed.

Banks at higher altitudes in the Blue Mountains; type collected by Forrest Shreve at Cinchona, November, 1905.

Chaenocephalus propinquus sp. nov.

A shrub, 2 m. high. Leaves firm in texture, oblanceolate, 5–9 cm. long, acute at the apex, cuneately tapering from above the middle to a sessile entire base, sharply and rather coarsely dentate above the middle, smooth on both sides or minutely scabrate-puberulent beneath, the pinnate venation not very prominent; inflorescence corymbose, 5–8 cm. broad; peduncles appressed-pubescent, 2–4 cm. long, nearly erect, or narrowly ascending; heads numerous, turbinate-campanulate, 6–7 mm. high; involucral bracts pubescent, the outer narrowly oblong to lanceolate, obtuse, 5.5 mm. long, the inner broadly oblanceolate, sharply acute, 5 mm. long, 2 mm. wide; corolla 3.5 mm. long, nearly cylindric above the narrowed base, its lobes triangular-ovate, acute; pappus-bristles about one half as long as the corolla; achene cuneate-oblanceolate, 4 mm. long, 1.5 mm. wide at the top, scabrous-pubescent, the wings nearly 1 mm. wide above.

In rocky soil, Lover's Leap, Yardley Chase, Santa Cruz Mountains, at 530 meters altitude (*Britton 1144*, Sept. 4, 1907; type; *Harris 9672*). Nearly related to *C. venosus* Urban, from wet woodlands on the summit of John Crow Peak, at 2000 meters altitude. (See Urban, Symb. Ant. **5**: 526.)

15. THE GENUS BADIERA DC.

BADIERA DC. Prodr. **1**: 334. 1824.

Type species: *Badiera Penaea* (L.) DC.

Leaves obovate to oblong, 1–4 cm. long, obtuse or emarginate.
Leaves obovate.
Pubescent; leaves 2–2.5 cm. long, papillose-scabrous. 1. *B. Penaea.*

Puberulent, leaves 1.5 cm. long or less.	2. *B. virgata.*
Leaves oblong.	3. *B. oblongata.*
Leaves ovate, oval or ovate-lanceolate, 2.5–9 cm. long.	
Leaves bluntly acuminate, or bluntly acute at the apex.	
Leaves 2–3 times as long as wide.	4. *B. diversifolia.*
Leaves less than twice as long as wide.	5. *B cubensis.*
Leaves rounded or emarginate at the apex.	6. *B. montana.*
Unknown to me, except from description.	7. *B. Berteriana.*

1. BADIERA PENAEA (L.) DC. Prodr. 1: 335. 1824

Polygala Penaea L. Sp. Pl. 703. 1753.

Polygala domingensis Jacq. Stirp. Am. ed. min. 252. 1788.

Badiera domingensis DC. Prodr 1: 335. 1824.

Mountains of Haiti and Santo Domingo. This plant is represented in the herbarium of the New York Botanical Garden by the following specimens: "In montibus, Hispaniola (Jacquemont); Sierra del Palo Quemado, Santo Domingo, at 500 meters (*Eggers 1897*); pineland, Marmelade, Haiti, at 900 to 1100 meters (*Nash 719; Nash & Taylor 1312*).

Professor Chodat ignores *Badiera Penaea* in his monograph, and describes *Eggers no. 1897* as *Polygala domingensis*, not recognizing the genus *Badiera*. Mr. Nash's *no. 719*, which is in young fruit, so closely resembles the original figure of *Polygala Penaea* L. (Plumier, ed. Burmann, *pl. 214. f. 1*) that it appears to me the two supposed species must be one; the character cited by De Candolle (Prodr. 1: 335) of flowers solitary in *B. Penaea* and flowers racemose in *B. domingensis* is doubtful; the Plumier figure shows the plant in fruit, and in this as in other species of the genus often only one flower of the cluster produces fruit.

2. **Badiera virgata** sp. nov.

A shrub or small tree up to 4 meters high, the branches nearly erect, densely leafy, the twigs finely puberulent. Leaves obovate, or obovate-oblanceolate, rigid, 10 mm. long or less, 4–8 mm. wide, puberulent or minutely papillose-puberulent, or becoming nearly or quite glabrous when old, rounded at the apex, or some of them slightly emarginate, narrowed at the base, the petioles pubescent, 1–1.5 mm. long, the midvein slightly elevated beneath, the lateral venation wholly obscure; flowers several in the axillary clusters or solitary, yellow-green, 2 mm. long; fruiting pedicels 1.5 mm. long; fruit 5 mm. long, the lobes narrowly winged (only imperfect ones with one lobe developed seen).

Thickets in dry soil, Oriente, Camagüey, and Santa Clara, Cuba. (Type, *Britton 2086*, from United States Naval Station, Guantanamo Bay, March 17–30, 1909.)

3. BADIERA OBLONGATA N. L. Britton, Bull. N. Y. Bot. Gard. **5**: 314. 1907

DISTRIBUTION: Bahama Islands: Andros, New Providence, Cat Island, Acklin's Island, Crooked Island, Watling's Island, Caicos Islands; Cayo Sabinal and mainland of Camagüey, Cuba (*Shafer 878 1085, 977*; also collected in Cuba by Wright, *no. 115* in part).

The Cuban specimens here referred have leaves mostly more obtuse at the base than those of the typical Bahamian plant, but a specimen from Andros Island (*Small & Carter 8681*) seems to be identical with them.

A plant from the palm barren at Santa Clara, Cuba (*Britton & Wilson 6066*), has shorter emarginate leaves 12–20 mm. long, with the midvein deeply impressed above; it is tentatively referred to this species.

4. BADIERA DIVERSIFOLIA (L.) DC. Prodr. **1**: 334. 1824

Polygala diversifolia L. Sp. Pl. 703. 1753.

Polygala jamaicensis Chodat, Mém. Soc. Phys. Genève **31²**: 11. 1893.

Jamaica, in hillside thickets and woodlands in relatively dry districts from sea level up to 1100 meters elevation.

5. **Badiera cubensis** sp. nov.

Polygala diversifolia Chodat, Mém. Soc. Phys. Genève **31²**: 10. 1893. Not L.

Leaves ovate to elliptic, 2.5–6 cm. long, 1.5–3.5 cm. wide, bluntly acuminate or acute at the apex, cuneate-narrowed or acute at the base; fruit 7.5–8.5 mm. long, 10 mm. wide, lobed to about one third, the lobes rounded.

Cuban woodlands; type, *Wright, no. 1913* from "La loma pelada, Dec. 27," in herb. N. Y. Bot. Gard.; also collected by Wright at "La Sabanilla" and distributed under this same number; Wright's *no. 3496* belongs to this species, and also part of his *115*, collected in eastern Cuba.

Professor Chodat indicates this Cuban species as occurring also in Jamaica, but this I take to be an error.

6. **Badiera montana** sp. nov.

A shrub, 3 m. high, the twigs densely puberulent. Leaves broadly oval, 4–5 cm. long, 2.5–3.5 cm. wide, firm in texture, quite densely puberulent when unfolding and sparingly puberulent when mature, rounded or slightly emarginate at the apex, acutish at the base, dull dark green, the midvein slightly impressed in the upper surface, elevated on the underside, the lateral veins few, slender, the rather stout puberulent petioles 2–3 mm. long; inflorescence several-flowered; bracts ovate, acute, pubescent, about 0.5 mm. long; fruiting pedicels pubescent, 1.5–2 mm. long; stipe of the fruit 1 mm. long; fruit 8–10 mm. long, 10–12 mm. wide at the top, puberulent, lobed to about one fifth, the lobes rounded-truncate.

Rocky wooded hill, Arroyo Grande, Trinidad Mountains, Cuba, at about 700 meters altitude (*Britton & Wilson 5461*, March 11, 12, 1910).

Differs from *B. cubensis* by its obtuse leaves, larger and longer fruit.

7. BADIERA BERTERIANA Spreng. Syst. **3**: 172. 1826

Described as with oblong-lanceolate obtuse leaves and recorded as from Hispaniola. Professor Chodat does not refer to this species in his monograph; it was collected by Bertero and called by him *Polygala domingensis*, but Sprengel's description indicates that it is not *Polygala domingensis* of Jacquin, here referred to *Badiera Penaea* (L.) DC.

EXCLUDED SPECIES.

Badiera (?) *acuminata* (Willd.) DC. Prodr. **1**: 335 is POLYGALA ACUMINATA Willd. Sp. Pl. **3**: 887, native of Peru and Chile. Professor Chodat describes it as new in his monograph (p. 46), but the name dates from at least the year 1803.

Badiera (?) *divaricata* DC. Prodr. **1**: 335, from Para, South America (presumably Brazil), was not taken up by Mr. A. W. Bennett in the Flora Brasiliensis.

Discoid gemmae in the leafy hepatics of New England

NEIL E. STEVENS

The gemmae found among the leafy Jungermanniales belong, with very few exceptions, to two distinct types. Those of the simpler type are unicellular or bicellular bodies which arise, generally in clusters, from the leaves or from the stem in the region of the apex. Those of the second type are discoid, multicellular bodies which are borne either on the margins or the surfaces of the leaves. The formation of the simpler type of gemma seems often to be associated with limitation of growth, for when the gemmae are borne on the stem the entire growing point goes over to the production of gemmae. The production of discoid gemmae, however, rarely seems to affect the growth of the plant to any marked degree. Gemmae of the simple type are of much more frequent occurrence, especially among northern forms, and are found in the vast majority of the gemmiparous New England species. Discoid gemmae occur, on the other hand, chiefly among the tropical epiphyllous forms. In New England they are known in only two species, *Cololejeunea Biddlecomiae* (Aust.) Evans and *Radula complanata* (L.) Dumort. According to Nees von Esenbeck discoid gemmae occur also on *Lejeunea cavifolia* (Ehrh.) Lindb. (*L. serpyllifolia* Lib.), but as he describes them, they represent here actual pieces of the leaf which become separated and are therefore hardly to be considered differentiated gemmae.

In the present paper the development and structure of the gemmae of *Cololejeunea Biddlecomiae* and *Radula complanata* are discussed. Both of these species are widely distributed in North America, and *Radula complanata* occurs also in Europe, Asia, and northern Africa. The material used in the study of *Cololejeunea Biddlecomiae* was collected by the writer in Woodbridge, Connecticut, in March. Material from Superior, Wisconsin, collected in August by G. H. Conklin, was used for comparison. The material of *Radula complanata* was collected in North Haven, Conn., in October, specimens collected at Woodbridge, Conn.,

in March, and at Lentz, Switzerland in September, being used for comparison. All the *Radula* material used was collected by Professor A. W. Evans.

But little has been written concerning the gemmae of the leafy Jungermanniales. In the tropical genus *Cyclolejeunea*, however, the gemmae have been described by Evans in four species. In *Cololejeunea* the development and structure of the gemmae have been described by Goebel in the Javan *C. Goebelii* (Gottsche) Schiffn. and by Cavers in the European *C. calcarea* (Lib.) Schiffn. For *Radula* the development of the gemmae has also been briefly treated by Goebel in two Javan species, *R. Hedingeri* Goeb. and *R. tjibodensis* Goeb., and by Cavers in *R. complanata*.

COLOLEJEUNEA BIDDLECOMIAE.

The gemmae in *Cololejeunea Biddlecomiae* are borne on the surface of the leaves, most frequently on the lower surface of the lobes, occasionally on the upper surface and never, at least in the material examined, on the lobules. Usually only a few, not more than five or six, are borne on a single leaf. Gemmae appear to be of rather general occurrence in this species, though only a comparatively small proportion of the plants in any individual mat are gemmiparous and plants bearing a considerable number of gemmae are found closely associated with plants having none. Gemmae are found more abundantly on sterile plants, but the presence of sexual organs by no means prevents the formation of gemmae. In fact they are found occasionally on the bracts, but never, so far as could be determined, on the perianths.

In the formation of a gemma a leaf cell first projects beyond the surface of the leaf and the projecting portion is cut off by a wall parallel to the leaf surface. The outer cell, which is nearly circular in outline, becomes the mother-cell of the gemma, while the inner one may be regarded as a stalk. The gemma mother-cell then undergoes a series of regular divisions by walls perpendicular to the surface of the leaf. The first wall divides it into two approximately equal parts (FIG. 1, A) and each of the semicircular cells then divides by a wall perpendicular to the first, so that the gemma in the four-celled stage consists at first of approximately equal quadrants (FIG. 1, B).

One of these quadrants in each half usually grows more rapidly than its sister cell and thus displaces the wall separating them, so that each half of the gemma soon consists of two unequal cells symmetrically placed with respect to the median wall (FIG. 1, C). Each of the larger cells then begins to function as a two-sided apical cell (FIG. 1, D and E) and cuts off three segments, the first by a wall approximately parallel to the median wall. Each segment in turn divides by a periclinal wall and the outer cell of the first segment divides further by an anticlinal wall. Each of the

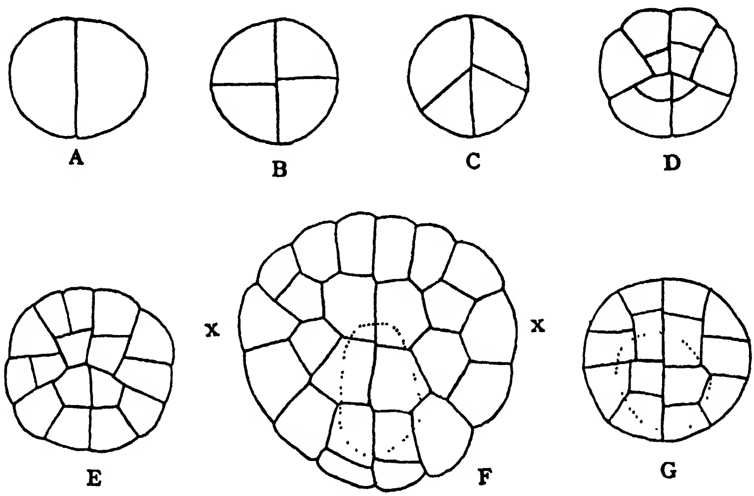

FIGURE 1. A–F. *Cololejeunea Biddlecomiae*. A–E. Gemmae in various stages of development, × 600. F. A gemma about ready to separate (x, apical cell), × 600. G. *Cololejeunea calcarea*. A gemma in which the basal and apical quadrants are nearly equal, × 600.

smaller, or basal, cells also divides regularly. The cell divisions normally take place exactly as they do in the first apical segment, so that each basal portion of the mature gemma contains three cells (FIG. 1, D and E). Occasionally, however, one of the outer cells divides again by a periclinal wall (FIG. 1, F).

The gemmae increase in size somewhat, after cell division has ceased, by the growth of the cells themselves; and this growth continues, for a time, after the gemmae are shed. This is clearly shown by the fact that the gemma, at the time it is shed, is about 0.035 mm. in diameter, while it is common to find gemmae loose

in the material containing precisely the same number of cells, yet having a diameter of 0.055 mm. or more. The cells of the gemma meanwhile increase proportionately in size, that is, from about 7 μ to about 12 μ in average diameter or to slightly less than the average diameter of the cells of the lobe.

A mature gemma is typically a flat disc consisting of a single layer of cells and showing no indication of dorsi-ventral differentiation. It is composed of symmetrical halves, each consisting of eleven or twelve cells. In each half eight of these cells come from the apical cell and its three segments and three or four come from the basal cell (FIG. 1, F). The gemma is regular in outline, without marginal hairs or other projecting cells, and there is no indication of rhizoids or other organs of attachment such as described by Goebel in the epiphyllous *C. Goebelii.* The one-celled stalk is attached to the gemma along the median line in the basal region (FIG. 1, F and G). The separation of the gemma takes place as in other *Lejeuneae* by the splitting of the cell wall between the stalk cell and the gemma.

The above description agrees closely with Goebel's account (50, *f. 55*) of the development of the gemma in *Cololejeunea Goebelii,* except that he describes the first anticlinal wall as dividing the semicircular cell into unequal portions. This condition in *C. Biddlecomiae,* at least, seems to be secondary, due to the more rapid growth of the cells which are to function as apical cells. This appears from the fact that the condition of equal quadrants (FIG. 1, B) is of frequent occurrence in the four-celled stages observed.

The development of the gemmae in *Cololejeunea Biddlecomiae,* as traced by the writer, differs in several respects from that figured by Cavers (160, *f. 8*) in the closely related *C. calcarea.* Cavers figures the cell divisions as taking place by cell walls parallel to and at right angles to the median line, without reference to an apical cell, and implies that the mature gemmae differ from those of *C. Goebelii* in not having an apical cell. He states also that the stalk cell is inserted at the center of the gemma. In order to determine whether *C. calcarea* really differs from other members of the genus in these respects, material from Pottenstein in Upper Franconia, Germany, collected by Arnold (Hep. Europ. *283b*)

was examined. This showed that the gemmae of the two species are essentially alike in their development, form, and method of attachment. One immature gemma of *C. calcarea*, however, was found in which the first anticlinal walls had not been displaced by the growth of the apical cells (FIG. 1, *G*). The basal and apical quadrants are thus nearly equal, and the gemma as a whole appears more like those figured by Cavers. It is very probable that it was from such a condition as this that his figures were taken.

RADULA COMPLANATA.

In *Radula complanata* the gemmae are borne on the edges of the leaves, frequently at right angles to the leaf surface. A single leaf often bears a considerable number of gemmae and it is common to find leaves where every cell for a considerable portion of the margin has given rise to a gemma. Gemmae are of more frequent occurrence in *R. complanata* than in most species. In fact so general is their occurrence that it is comparatively rare to find well-developed plants which do not bear gemmae. Moreover, it is evident that there can be here no such antagonism between the production of gemmae and of sexual organs as has been supposed by some writers, for the gemmae are frequently borne on the edge of the perianth itself, as well as on the bracts.

Each gemma arises from a single marginal cell, which projects beyond the cells on either side and becomes at once the mother-cell of the gemma. This cell as it increases in size secretes a gelatinous substance which may be noted around the edge of the cell. The secretion of this gelatinous substance appears to be characteristic of rapidly growing cells in the gemma and the occurrence of gelatinous material in considerable quantity may be taken as a rough indication of the region of most rapid cell division (FIG. 2, *A*, *C*, and *D*; FIG. 3, *A*; and FIG. 4, *A* and *C*). The gemma mother-cell divides first by a periclinal wall (FIG. 2, *A*). This wall is sometimes perpendicular to the surface of the leaf, but is more often so inclined that the outer of the two cells, which is generally the larger, overlies a portion of the inner cell. The outer cell, which gives rise to the main portion of the gemma, divides first by a longitudinal wall (FIG. 2, *B*). The inner cell divides later by a longitudinal wall and forms the two-celled basal

portion of the gemma, which may be regarded as a poorly defined stalk.

The two cells formed by the division of the outer cell behave as more or less independent portions. They divide without very definite order by transverse and longitudinal walls (FIG. 2, *C*) and soon a wedge-shaped cell is cut off in one (FIG. 2, *D*) or both (FIG. 2, *E*) of the portions. These cells function for a while as two-sided apical cells. The irregular occurrence and behavior

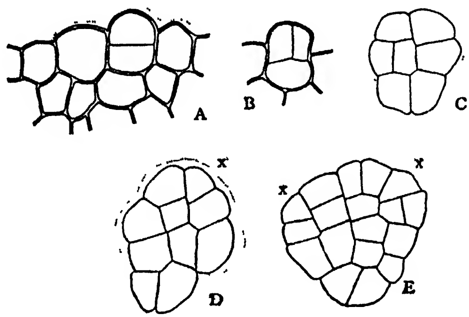

FIGURE 2. *Radula complanata*. *A-C*. Gemmae in early stages of development, × 300. *D*. Gemma that has formed one apical cell, × 300. *E*. Gemma with two apical cells, × 300. Dotted line indicates gelatinous secretion.

of these apical cells gives rise to the considerable variation in form which is to be observed in the gemmae of *Radula complanata*. For both portions may cut off apical cells at the same time and develop with equal rapidity, thus forming a symmetrical gemma, or one segment only may form an apical cell, in which case the segment which has no apical cell will develop very little and will be more or less crowded out of position. Such a gemma is shown in FIG. 3, *A*. One portion has here developed an apical cell which has cut off six segments. This portion has increased by further cell divisions until it is composed of twenty-three cells, while the portion having no apical cell is composed of but four cells.

Moreover, the apical cells do not persist until the gemma is mature; but, after cutting off segments in regular succession for a time, lose their capacity of regular segmentation and divide by a periclinal wall (FIG. 3, *B* and *C*). After this first periclinal division the apical cell divides like other cells by longitudinal and

transverse walls, but the segments which have arisen directly from the division of an apical cell may generally be traced by their position in the mature gemma. In gemmae having two apical cells one may continue to function as an apical cell after the other has lost its power of regular segmentation and has begun to divide by periclinal and anticlinal walls (FIG. 3, *D*). This gives rise to still greater irregularity in the mature gemmae. The usual position of the mature gemmae, at right angles to the plane of the leaf, seems to be due to the crowding of the gemmae as they increase in size. For the gemmae are at first in the plane of the leaf and remain so in places where they are not close together.

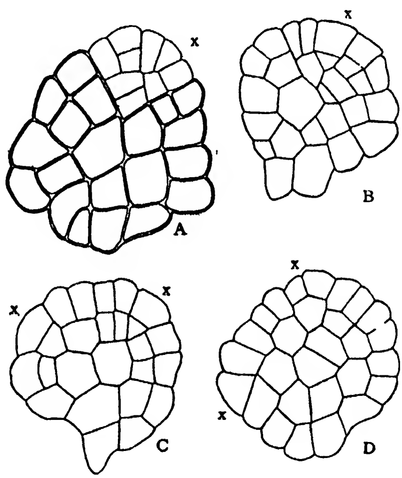

FIGURE 3. *Radula complanata*. *A*. Gemma with one apical cell. *B–D*. Gemmae in which the apical cells have ceased to cut off regular segments and have divided irregularly. × 300.

The active division of an apical cell tends to inhibit the division of other cells in the gemma. This appears from the fact that when one apical cell is present the portion lacking an apical cell exhibits very little cell division. It is shown still more strikingly, however, by the fact that about the time the apical cell loses its power of active segmentation the older cells of the gemma begin to divide by walls parallel to the surface.

A mature gemma, that is, one ready to fall from the leaf is thus typically two cells thick for a considerable part of its extent (FIG.

4, *A* and *B*). The marginal cells, however, rarely divide by walls parallel to the surface and the basal cells never take part in this division. In this respect *R. complanata* apparently differs markedly from other members of its group. For in all the other leafy Jungermanniales thus far observed, which bear thalloid gemmae, the gemmae are but one cell thick throughout (Evans, 298).

In the mode of separation of the gemmae, also, *Radula complanata* differs from many other leafy Jungermanniales. For while the separation is schizolytic, the splitting takes place in the wall between the basal cells and the cells of the leaf. The two-celled

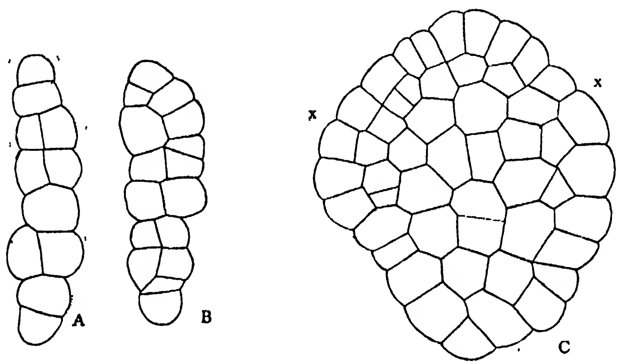

FIGURE 4. *Radula complanata.* *A* and *B*. Mature gemmae in optical section. *C*. Surface view of mature gemma. × 300.

stalk is thus retained as a part of the mature gemma when it falls from the plant. This is very different from the condition found in *Cololejeunea*, where the separation takes place between the gemma and the stalk cell. A similar difference has been noted by Evans (277, 284, *f. 4, 9*) in the separation of the gemmae in *Metzgeria*. In *M. crassipilis*, for example, the gemmae are set free by a splitting of the wall between the gemma and the cell cut off by the original horizontal wall, while in *M. furcata* separation takes place by the basal cells splitting away from the adjacent thallus cells.

In no case was a mature gemma observed which still retained an apical cell. This is contrary to the statement of Cavers (159) that the mature gemma "shows on its distal margin a large apical cell, triangular in surface view."

The development of the gemmae in *Radula complanata* differs considerably from that of *R. Hedingeri* as described by Goebel (52). He states that the gemma mother-cell divides by a number of longitudinal walls between which transverse walls are formed and that no apical cell is developed in the gemma. That this is not the case in *R. complanata* is clear from the almost invariable occurrence of apical cells in the young stages observed, and from the fact that in mature gemmae the position of the apical cell may generally be traced. FIG. 4, *C*, shows what may be considered a typical gemma. In this the outlines of the two apical cells with their segments may be clearly traced though each of the apical cells has become divided into five cells.

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Notes on Rosaceae — III

PER AXEL RYDBERG

POTENTILLA

If we were trying to trace the origin of the name *Potentilla*, we should probably find that the name belonged to *Potentilla Anserina* L., or *Argentina Anserina* of the North American Flora. There is no doubt but that very species was the plant usually referred to by the name *Potentilla* among the pre-Linnaean botanists, although other species, as for instance *P. reptans* L., sometimes were meant. As our nomenclature begins with Linnaeus, it concerns us very little, however, what his predecessors named plants. The question that most concerns us is, What application did Linnaeus make of the name *Potentilla?* We know that Linnaeus often adopted names from earlier authors and used them in an entirely different meaning.

As stated before, our nomenclature begins with Linnaeus, and we have agreed to adopt the Species Plantarum of 1753 as the starting point of generic as well as of specific names. As the Species Plantarum does not give any characterization of the genera, and as there are found only a few exceptional cases in which types are assigned, it is necessary to turn to other works of Linnaeus, in order to find his real conception of a certain genus at that time. The best book for this purpose is the fifth edition of his Genera Plantarum, published in the following year. In this we find on page 219 that the genus no. 559, *Potentilla*, was not adopted from anybody else. In other words, whatever the origin of the name *Potentilla* might have been, the concept of the genus originated with Linnaeus himself.* He based it on *Quinquefolium* Tourn. and *Pentaphylloides* Tourn. As *Quinquefolium* is the first of these two synonyms and the only one accompanied by an illustration,† also cited by Linnaeus, we can not help but regard the

*Linnaeus had the same concept even before the publication of the Species Plantarum, for his genus *Potentilla* remained unchanged in his Genera Plantarum from the first edition to the seventeenth, the last one printed during his lifetime.

†Tourn. Inst. *pl. 153*.

type of *Quinquefolium* Tourn. the type of *Potentilla* L. The plant figured by Tournefort is *Potentilla reptans* L. Tournefort had adopted the name *Quinquefolium* from Caspar Bauhin.* The latter referred directly to the *Pentaphyllon* (πενταφυλλον) of Dioscorides and Theophrastus and Pliny's *Quinquefolium*, all evidently the official plant *Potentilla reptans.* The plate in Dioscorides (Codex Vindobonensis, of which there is a photographic facsimile copy in the library of the New York Botanical Garden) may very well represent *P. reptans*, or at least a species of *Potentilla* with digitately 5-foliolate leaves, 5 petals, and decumbent stem, rooting at the nodes.

A few botanists are inclined to regard the first species mentioned as the type of the genus. The first species of *Potentilla* is *P. fruticosa* L., but this was not a part of Tournefort's *Quinquefolium.* The first Tournefortian species of that genus, cited by Linnaeus, is *P. recta*, and the first Linnaean species given in Tournefort's Institutiones, is *P. alba;* but neither of these agrees with Tournefort's plate, nor can they be traced back to the old Greek and Latin writers, from whom Tournefort adopted the name *Quinquefolium.* There is therefore no species which can dispute the right of *P. reptans* as being regarded as the type of *Potentilla*, except *P. Anserina*, and the latter can do so only if we admit a pre-Linnaean starting point of our nomenclature.

The type of *Tormentilla* L.† is *T. erecta* L., or *Potentilla Tormentilla*, a 4-merous species of the same group as *P. reptans.*

The type of *Quinquefolia* (Tourn.) Adans.‡ and of *Pentaphyllum* Gaertn.,§ is of course also *P. reptans.* The proposing of another genus *Callionia* Greene|| was, of course, altogether superfluous, for its type, *Potentilla canadensis* L., is so closely related to *P. reptans* that no scientist would seriously think of placing them in different genera. In proposing *Callionia*, the author says: "If *Argentina* be separated from *Potentilla*, it is by habit and inflorescence alone and from this there seems to follow necessarily the conceding of equal rank to what I shall call *Callionia.*"

*Pinax 325.
†Sp. Pl. 500. 1753.
‡Fam. Pl. 2: 295. 1763.
§Fruct. 1: 349. 1788.
||Leaflets 1: 238. 1906.

Even if there were no structural differences in the flowers of *Argentina* and *Potentilla* (which, however, exist), there are not even any essential habitual differences between *P. canadensis*, *P. simplex*, and *P. pumila* on one hand, and *P. reptans*, *P. procumbens*, and *P. Tormentilla* on the other.

Dactylophyllum Spenner* was a merging of *Potentilla*, *Fragaria*, *Sibbaldia*, etc., without any real type.

The types of *Chamaephyton*, *Dynamidium*, and *Hypargyreum* Fourr.† are *Potentilla supina* L., *P. verna* L., and *P. argentea* L., respectively. Fourrier also proposed several other genera, of which *Drymocallis* was adopted by me for *P. rupestris*, *P. glandulosa*, and their allies. The rest of Fourrier's genera are not represented by American species. Whether they should be regarded as distinct genera or not, can be decided only by further study, and was out of the scope of the North American Flora.

The monotype of *Potentillopsis* Opiz is *Potentilla pentandra* Engelm.

Tridophyllum Necker‡ has no type. It was based on the trifoliolate species of *Potentilla* L., of what book of Linnaeus Necker does not state under *Tridophyllum;* but on page 94 we find that he had in mind the 14th edition of the Systema. This mattered little, however, in this case, because this division of *Potentilla* remained unchanged from the first edition of the Species Plantarum to the 14th edition of the Systema, the first and the last of the works of Linnaeus that Necker possibly could have had. The group contained *P. monspeliensis*, *P. norvegica*, *P. nivea*, *P. grandiflora*, and *P. subacaulis*. Only the two first belong to *Tridophyllum*, as modified by Dr. Greene.§ He states: "Among all segregated genera that have been proposed, not one is better entitled to the rank of a genus than Necker's *Tridophyllum*. As its name indicates, it is founded upon species of Linnaean *Potentilla* having trifoliate leaves. But this mark of the foliage is not one which is considered essential. He makes the generic rank of the group to rest on the very small ovaries, greatly reduced styles and minute naked achenes. The so-called Potentillas that

*Fl. Frib. 1084. 1829.

†Ann. Soc. Linn. Lyon II. 16: 371. 1868.

‡Elem. 2: 93. 1790.

§Leaflets 1: 188. 1905.

evince these characters have other marks more obvious. Their roots are annual, or now and then of biennial duration. All other plants that ever were referred to *Potentilla* are perennial, and very many suffrutescent." So far, Dr. Greene. Let us see of what value these characters are. *Potentilla nivea*, *P. grandiflora*, and *P. subacaulis*, also trifoliolate species of the Linnaean *Potentilla*, and hence part of *Tridophyllum* Necker, do not fulfill this characterization. Some may claim that they did not constitute a part of Necker's genus, but why not? Necker placed the pinnate-leaved species in *Potentilla*, the trifoliolate ones in *Tridophyllum*, and the digitate-leaved ones with more than three leaflets he transferred to *Tormentilla*. In a note under *Tormentilla* he states that 5 species of *Potentilla* are to be referred to *Tridophyllum;* hence the five given above, of which *P. subacaulis* has very long styles and the other two have rather large achenes. They are all three perennials.

But is *Tridophyllum* as modified by Greene a well-defined genus? *Potentilla intermedia* and *P. heterosepala* have both the very short styles and numerous small achenes, and are both included in the SUPINAE group by Dr. Wolf, the world-authority on *Potentilla;* but they are both perennials. The former is very close in habit to *P. monspeliensis*, which occasionally is a short-lived perennial. *Potentilla Newberryi* has all the character of that group, but the style is long. The short style, often glandular at the base, and the numerous small achenes, characteristic of the SUPINAE group, are found in many other Potentillas, especially of the MULTIFIDAE group. These characters are worth little as generic characters.

While vol. 25, part 4, of the North American Flora was going through the press, we received at the New York Botanical Garden the excellent monograph of the genus *Potentilla* by Dr. Theodor Wolf.* If this valuable work had reached us a little earlier, some changes and corrections might have been made in my monograph, and quite a number of synonyms could have been added. The monographing of the whole genus, for the whole world, is a stupendous undertaking. Dr. Wolf's work is one of the most elaborate, conscientious, and critical ever published. It is a large

*Bibliotheca Botanica. Heft 71.

quarto of 716 pages and 20 plates, good paper and good large print. The descriptions in Latin are excellent and complete. To these are added elaborate discussions and notes in German. The synonymy is practically complete, and the citations have nothing of the vagueness so characteristic of many so-called monographs.

As one should expect, a comparison of Dr. Wolf's monograph and my treatment of the genus in the North American Flora discloses many differences; but most of these result from our different views. Dr. Wolf is exceedingly conservative both as to genera and species, and the present writer has the reputation of being exceedingly "radical." Dr. Wolf believes in large genera and broad species, and admits numerous varieties and forms; while the writer believes in small genera and narrowly limited species. If the diversity of two plant forms is of any value at all, the writer admits them as distinct species; if the variation is a trifling one, it is simply ignored. In this way the old rank of variety has been disposed of. Of course, also, many of the differences arise from the fact that Dr. Wolf had no or insufficient material of American plants and had to rely upon the printed descriptions alone in many cases.

While Dr. Greene seems to go too far in splitting up the genus, Dr. Wolf is in my opinion too conservative. He has left *Potentilla* with about the same limitation as Lehmann had in 1856, only that he has merged even *Duchesnea* in *Potentilla*. I can not understand why he did not treat *Sibbaldia* in the same way. This genus is really much more related to *Potentilla* than *Drymocallis* and *Dasiphora* are. The only distinctions given by Dr. Wolf are: "Stamens 5 (very seldom 10); carpels 5–15 (the few Potentillas with only 5 stamens have always numerous carpels)." But there are several Potentillas that have few carpels although they have 10–20 stamens. The distinctions are therefore not well drawn. Of course the position of the style, which I have used as a generically distinctive character, will place it outside of *Potentilla* proper and in the group with *Dasiphora*. Dr. Wolf, however, does not regard this as a generic character and therefore, if consistent, he should have merged *Sibbaldia* into *Potentilla*.

Dr. Wolf has divided the genus *Potentilla* into 2 sections and 6 subsections. These subsections are based on the differentiation

of the styles. It is practically the same character as I used in distinguishing the genera, only that I placed more importance on the position and Dr. Wolf on the form of the style. I also took the stamens into consideration, which Dr. Wolf only incidentally mentions. Dr. Wolf's RHOPALOSTYLAE correspond to my genus *Dasiphora.* His NEMATOSTYLAE correspond to *Sibbaldiopsis* and *Comarum*, together with several groups not American and therefore not treated by me. These two subsections constitute his section POTENTILLAE TRICHOCARPAE. It is evident that *Comarum* (*Potentilla palustris* of his monograph) should not be counted in this section, as the carpels are perfectly naked. He associates *P. palustris*, a herbaceous plant with creeping rootstock and glabrous achenes, with *P. Salesowiana*, a shrub with hairy achenes. While the latter is in its right position in the system, the former is not. I shall discuss this further under the genus *Comarum.* To Dr. Wolf's POTENTILLAE GYMNOCARPAE belong the rest of the subsections. CLOSTEROSTYLAE correspond to the genus *Drymocallis* and LEPTOSTYLAE to *Argentina.* The subsections CONOSTYLAE and GOMPHOSTYLAE show so many intergradations, a fact admitted by Dr. Wolf, that there is no ground, in my opinion, for keeping them apart. They constitute what I have called *Potentilla.* In the main points Dr. Wolf and myself agree, the only difference being that what he calls subsections, I call genera. I can not help, however, but accuse Dr. Wolf of inconsistency, for *Sibbaldia*, *Fragaria*, *Horkelia*, *Comarella*, and *Stellariopsis*, all admitted by Dr. Wolf, are none of them better genera than these subsections.

Now let us take up the different groups of *Potentilla* in the order they are in the North American Flora.

TORMENTILLAE

This contains six species, of which two, *Potentilla reptans* and *P. procumbens*, are introduced. Dr. Wolf admits only one North American species, regarding *P. pumila* and *P. simplex* as varieties of *P. canadensis.* *Potentilla caroliniana* was evidently unknown to him. Regarding *P. pumila*, he states that I regarded it in 1898 as a distinct species but withdrew the rank in 1899 (refering to the Bulletin of the Torrey Botanical Club for that year,

page 25), after Clute had reported *P. canadensis* and *P. pumila* as growing together on the sand barrens of Long Island and were "connected through intermediate forms." The page referred to contains the proceedings of the Club. I had nothing to do with it and my name was not even mentioned. Clute's report on the sand barren flora contains a statement very opposite to what Dr. Wolf gives, viz.: "*Potentilla pumila* and *P. canadensis* growing together without intermediate forms." Robinson and Fernald, who give *Potentilla* a very conservative treatment in Gray's New Manual, keep them distinct, although they regard *P. simplex* a variety of *P. canadensis*. I for some time thought that an additional species could be distinguished from *P. canadensis*, viz., the plant common in the lower Mississippi Valley. This has much thicker and more shining leaves and usually longer bractlets than the common *P. canadensis* of the North Atlantic States, but these characters were found to be too unstable and the plant grades so into the typical form that the idea was given up.

HETEROSEPALAE

This group contains only one species from Mexico and Central America. Dr. Wolf refers it to the SUPINAE group, perhaps rightly so.

SUPINAE

In the North American Flora 12 species are admitted. Of these, *Potentilla rivalis*, *P. millegrana*, *P. biennis*. *P. michoacana* and *P. pentandra* are regarded by Dr. Wolf as distinct species; and *P. paradoxa* and *P. monspeliensis* are regarded as varieties of the European *P. supina* and *P. norvegica* respectively. *P. Nicolletii* is made a mere form (f. *decumbens*) of *P. supina paradoxa*. A comparison between this treatment and the one in Gray's New Manual is rather interesting. In that publication *P. Nicolletii* is regarded as a good species, while *P. millegrana* and *P. pentandra* are made varieties of *P. rivalis*. Whatever may be said, *Potentilla Nicolletii* is a rather weak species, while *P. pentandra* is one of the most distinct in the group. Opiz even based a new genus on the same. It is also interesting to know that the specimen which Sheldon had most in mind when he raised *P. Nicolletii* to specific rank and which he distributed under that name,

was not a specimen of *P. supina Nicolletii* S. Watson or *P. Nicolletii* of my monograph, but of *P. millegrana*.

Dr. Wolf claims that *Potentilla labradorica* Lehm. is but a depauperate form of *P. norvegica hirsuta* (*i. e.*, of *P. monspeliensis*). Lehmann's description, however, suggests another plant, differing from that species not only in the almost complete lack of pubescence but also in the obtuse and oval instead of lanceolate bractlets, the broader obcordate petals and smooth instead of rugulose achenes. It is a subarctic plant and evidently the same as *P. flexuosa* Raf., an older name.

The remaining species, *Potentilla flavovirens*, *P. Kelseyi*, and *P. leurocarpa* were described as new in the North American Flora, and were evidently unknown to Dr. Wolf. They are all three very local. *P. Kelseyi* may be a hybrid between *P. biennis* and *P. monspeliensis*.

ARENICOLAE

This contains only one species, *P. Newberryi*, which Dr. Wolf includes in the preceding group.

ARGENTEAE

This group is a rather artificial one and if I had had Dr. Wolf's monograph at hand when the manuscript was prepared I should have made other arrangements. The group consists of four introduced species. Of these Dr. Wolf has placed *Potentilla intermedia* in the SUPINAE group on account of its short style. It is evidently related to that group and often closely resembles *P. norvegica* but is an evident perennial. Most specimens of this species collected in this country belong to a form with the leaflets more deeply dissected and inclined to be more or less pedately instead of strictly palmately arranged. This form was described as *P. digitato-flabellata*, from seed said to have come from America. Perhaps it is a native and distinct from the European species. I have never seen it growing. It would be worth while for botanists who have the opportunity to see it in the field to give it a thorough study. *P. argentea* is rather common and is found in this country in many forms. I did not take the trouble to try to identify these with the numerous described varieties.

RECTAE

This group contains two closely related introduced species. Dr. Wolf regards them as varieties of one.

HEPTAPHYLLAE

This group consists of a single species, which Dr. Wolf includes in his Grex *Ranunculoides*, a mixture of plants of diverse habits, from the groups *Heptaphyllae*, *Aureae*, *Subviscosae*, *Subcoriaceae* and *Nuttallianae*. In my monograph I had followed S. Watson in calling the species *Potentilla heptaphylla* Mill. It is not closely related to that species. For some years I had known my mistake but did not correct it until I did so in the North American Flora. Dr. Wolf had also noticed it and proposed a new name for the species. As his name is a few months older, the species has to bear the following name and synonymy.

POTENTILLA PALMERI Th. Wolf. Bibl. Bot. **16**: 513. 1908

P. heptaphylla S. Wats. Proc. Am. Acad. **17**: 353; hyponym. 1882.—Rydb. Mem. Dep. Bot. Columbia Univ. **2**: 62. 1898. Not *P. heptaphylla* Mill. 1768.

P. leptophylla Rydb. N. Am. Fl. **22**: 310. N 1908.

NUTTALLIANAE

Coulter and Nelson, in the New Manual of Botany of the Central Rocky Mountains, have reduced *Potentilla brunnescens* Rydb. to a doubtful synonym of *P. pectinisecta*, to which it has indeed very little relationship. Its nearest relative is without doubt *P. Nuttallii*. Dr. Wolf, who is even more conservative as a rule than the authors of the New Manual, admits it as a distinct species, but changes the name to *P. brunescens*, for what reason I do not know. As far as I know, both *brunneus* and *brunnescens* are usually spelled with two *n*'s.

Potentilla Townsendii is placed in the *Ranunculoides* by Dr. Wolf and placed between *P. fragiformis* and *P. Palmeri;* but it is not related at all to either of the two. It has no close relative as far as I know, but must be placed in the group in which I placed it in the North American Flora, unless it is to be regarded as a group by itself.

The only species in North America which resembles it in leaf-form is *P. angustata* Rydberg, proposed as new in the North American Flora, but this is much more closely related to *P. Nuttallii.* It is known only from the type collection.

The new species proposed in this group are *Potentilla angustata, P. grosse-serrata, P. rectiformis, P. amadorensis, P. macropetala, P. Parishii, P. dascia,* and *P. lasia.*

Potentilla grosse-serrata was based partly on material referred by me in my monograph to *P. Blaschkeana.* As treated there, the latter species was composed of a mixture of *P. grosse-serrata, P. glomerata* A. Nels., *P. dascia* Rydb., and the true *P. Blaschkeana* Lehm. I shall give a further discussion under the latter species. Some of the more typical specimens of *P. grosse-serrata* are here given:

CALIFORNIA: Donner Lake, 1865, *Torrey 121* (*a*); *Bridges 98;* between Igera and Weed, 1905, *Heller 8092;* (Geological Survey 1860–7) *Rattan 234.*

NEVADA: Ruby Valley, 1868, *S. Watson 339.*

WASHINGTON: *Vasey 322.*

When preparing the manuscript of my original monograph, I had two specimens, rather fragmentary, of *Potentilla rectiformis.* One was doubtfully and hesitatingly referred to *P. recta,* the other to *P. pectinisecta.* The following specimens belong here:

WASHINGTON: Pullman, 1896, *Elmer 29,* "Kuskuske and Fort Vancouver," *Wilkes.*

MONTANA: Spanish Basin, 1897, *Rydberg & Bessey 4379.*

Potentilla amadorensis is known only from the type locality.

Potentilla macropetala resembles much in habit *P. glaucophylla* but has much larger flowers. The stem is also much stouter and and the plant much coarser, wherefore it was placed here rather than in the MACULATAE. To this species I refer the following specimens:

CALIFORNIA: Laguna, 1894, *Schoenfeldt 3576;* 1866, *Bolander 5036;* San Diego, *Palmer.*

OREGON: Tillamook, 1894, *Lloyd.*

Potentilla Parishii is closely related to *P. Hallii* and the first specimens seen were referred to that species by me a few years ago, but it differs in the fine appressed instead of spreading and

coarser pubescence of the stem. The following specimens are referred here:

CALIFORNIA: Descanso, 1897, *Parish 4523;* Cuyamaca Lake, 1903, *Abrams 3871;* San Jacinto Mountains, *Hall 2296;* Fresno County, 1900, *Hall & Chandler 182*, in part; Laguna Mountains, San Diego County, 1904, *Brandegee.*

Some of the specimens belonging to *Potentilla dascia* were included in *P. Blaschkeana* in my monograph. Later I referred them to *P. glomerata* A. Nelson. It is evidently related to the latter, but differs in the open inflorescence and the pubescence, which is much coarser and not at all tomentose, but slightly puberulent as well as hirsute on the lower surface of the leaves. I refer here:

WASHINGTON: 1889, *Vasey 320;* Ellensburg, 1897, *Piper 2736;* Wilson Creek, 1892, *Lake & Hull 518*; Wilson Creek, 1893, *Sandberg & Leiberg 315.*

OREGON: Dalles, 1869, *Harford & Dunn 1144.*

MONTANA: Bozeman, 1892, *Mrs. Alderson*; 1874, *Coues.*

Potentilla lasia is related to *P. Hallii* but is characterized by the few and large teeth of the leaves and the oblong-lanceolate instead of narrowly linear-lanceolate bractlets. To it are referred:

CALIFORNIA: Schwartout Cañon, San Antonio Mountains, 1899, *Hall*; Bear Valley, San Bernardino Mountains, 1894, *Parish 3252;* Los Angeles County, 1899.

Dr. Wolf reduces *Potentilla Hallii* to a variety of *P. gracilis*, evidently without having seen a specimen. This is not the only case he has treated in that way, for in about half the cases where species have been described by later authors, he has reduced them to varieties of what seemed to him the nearest species. In habit the plant resembles much more what Dr. Wolf describes under the name *P. pulcherrima*, than *P. gracilis*, but it lacks tomentum on the lower surface of the leaves and therefore should be placed near *P. etomentosa* in the *Nuttallianae* group.

Dr. Wolf admits *Potentilla etomentosa* as a valid species, citing specimens from Wyoming. Not all species so named from Wyoming belong to *P. etomentosa*, for some are *P. jucunda.* The latter he reduces to a variety of *P. diversifolia*, claiming that he can scarcely separate it from the variety *glaucophylla.* This

statement he bases on specimens received from me, collected at Chambers Lake, Col. In the Chamber's Lake collection, distributed by the Agricultural College of Colorado and named by me, large specimens of *P. glaucophylla* and rather small ones of *P. jucunda* were mixed. I did not notice this fact when the specimens were sent out and Dr. Wolf may have received specimens of the former instead of the latter.

In the New Manual of the Central Rocky Mountains the author of the name *Potentilla jucunda* has reduced it to a synonym of *P. Nuttallii*, but it differs in the total lack of the glandular pruinosity characteristic of that species, in the thinner leaflets, and less prominent veins.

As an appendage of this group, I added two Mexican species, *P. oaxacana* Rydb. and *P. Goldmani* Painter, with thicker leaves and but 5 leaflets to the basal leaves. They are known only from the type localities.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1900–1909)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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BULLETIN

OF THE

TORREY BOTANICAL CLUB

AUGUST, 1910

Have we enough New England blackberries?

EUGENE P. BICKNELL

What are we to believe about our wild blackberries? Has nature bestowed on our flora really many more than those few well-accredited species which have come down to us from our botanical forefathers, or are our woods and fields crowded with the brave number which recent years have spread on the botanical page and which, by the token of their array, may yet be infinitely multiplied?

Our wise forefathers in the restraint of their learning were cautious in their treatment of this suspiciously unconventional group of plants—too cautious, it may be, and perhaps not so wisely restrained after all. Quite possibly their example of conservatism carried its influence too securely into the widened outlook of the present day and some form of reaction was predestined to follow in the accounting. Be this as it may, the spell has finally been broken, and lo,—the fragments!

What is the blackberry situation at this hour? It is indeed an unhappy heritage. Where angels had feared to tread the ground has been traversed, and so unforbearingly, notwithstanding the briers, that not any semblance of a pathway has been suffered to exist.

My study of the flora of Nantucket in course of publication has led me, reluctant, into the general blackberry problem. No evasion was possible. Many unusual forms of blackberries are found on Nantucket and, in order to discuss them at all, it was necessary first to determine whether any or all of them had been

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accounted for in recent print. If the study of what had thus been offered should fall into no final Rafinesquian entanglement, there was the hope that it might unfold some long concealed but consistent and beautiful multiple structure of evolution's handiwork. And if, peradventure, there should be disclosed any sad mixture of dislocated facts and naïve fancies, then those unwisely conservative botanical forefathers should be held to their proper blame. In any case, the problem required some attempt at solution. Hence these lines.

Two fundamental facts about our blackberries should not long escape the most casual student. Even the least unstable species possess some kind of ready pliancy, which answers, often with marked emphasis, to slightly changed conditions of growth; and, further, all the species by some freely practised method of versatility acquire variously in combination with their own proper characters the features of associated members of their group. These facts import an extraordinary natural variability and undoubtedly, also, a facility in hybridizing which is perhaps not exceeded in any other genus of our flora.

A number of years ago, before these facts were well apprehended, the blackberries of York County, Maine, excited my wonder and engaged my particular attention. Who knows but that for a warning sounded by President Brainerd the observer of those days might have complacently occupied the pitfall which thus invited any artless and too self-assured purveyor of spurious species? President Brainerd's admonition, which was not unduly apprehensive, as later events have shown, may well be quoted here: "Our American blackberry is so excessively variable that in order to be completely understood it may in time need to be presented under as many mental types. But we most sincerely hope that only experts—after years of study—will attempt it."*

Since the day of that admonition, York County, Maine, has become distinguished as a stronghold of blackberry trouble. Here a Canadian flora is thrown out along a partly deforested country fronting the ocean shore, which has also received a counter-invasion of the coastwise flora of more southern New England. The condition of compression within this coastal strip may well

*Rhodora 2: 23, 24. F 1900.

be supposed to produce a tension between two distinct floras not usually brought into contact, and to place many plants in unaccustomed relations of contiguity. Among plants capable of hybridizing such conditions could scarcely fail to give the opportunity.

The intricate taxonomic problem presented by our blackberries has long been to the writer a most fascinating subject of attention, but without the opportunity of adequate study, and the conclusions which the present situation in the group has here called prematurely into expression are advanced with many reservations.

Something like fifty new blackberry names have been added to the lists during recent years. Of these the majority, some forty or more, have been promulgated by Mr. W. H. Blanchard from the general New England region. Full sets of specimens bearing these new names have been distributed. They have been well collected and better herbarium material need not be desired. Those deposited in the herbarium of the New York Botanical Garden have been utilized in the present study.

It would scarcely yet be the part of wisdom to accept any one of these new names as denoting a valid species nor, on the other hand, is there sufficient warrant in our present knowledge for reporting all of them as being without standing. I should suppose, however, that some sixty per cent. of the number might be allowed to pass into the category of synonyms; the remainder, possibly with a few exceptions, appear to disclose themselves as scarcely doubtful hybrids. It should be said at once, however, that no sufficient proof, properly so considered, can be adduced in support of this view. But every reasonable probability of circumstantial evidence points to such a conclusion; it seems to meet the requirements of a correct working hypothesis among the multitude of interrelated forms which the group presents and to satisfy various theoretical tests. Nevertheless, in so general a commitment of alleged new species it is more than possible that mistakes have been made and that there may be some members of wholly unblemished origin which should be rescued from the asylum of bastards.

As to the valid New England blackberries I see little reason to doubt that we have at least eleven species in the *Eubatus* group, here alone considered, as follows:

Rubus allegheniensis Porter.
argutus Link.
canadensis L.
cuneifolius Pursh.
frondosus Bigelow.
nigricans Rydb.
hispidus L.
procumbens Muhl.
Baileyanus Britton.
Enslenii Trat.
flagellaris Willd.

Under these names, if I have not wholly misconceived the problem, all or nearly all more recent names may be disposed somewhat in accordance with the arrangement in the following tables. The problem is made very intricate by reason of the extreme variability of the apparent hybrids, which would appear to have acquired a compound tendency to variation through their double inheritance. And there are indications that compound hybrids have also to be reckoned with. What appear to be the product of the same crosses present themselves under many different aspects according as they resemble one or the other parent or variously combine the characters of both. And the crosses appear to reflect also the fluctuating forms of development to which the parents are subject under varied conditions of growth and in different parts of their range. So freely do our species appear to hybridize that there would seem to be little reason to doubt that every one of them holds the capability of crossing with every other one. There is thus among the species here enumerated, omitting *Rubus cuneifolius*, only a local plant in New England, a potentiality of forty-five primary hybrids, and nearly all of this possible number appear to be accounted for by existing forms. Some of these seem to announce their parentage quite unmistakably, while others offer mere suggestions only, easily misinterpreted, of what their origin may be. The final word is not for the systematist but for the experimental culturist and must rest on the demonstration which induced crossing can alone supply.

Not all of the species here taken to be valid are secure against the test, having its advocates, that species may not intergrade.

It would need a very keen botanical eye to discover inviolable boundary lines separating *Rubus allegheniensis* from *Rubus canadensis* on the one hand and from *Rubus argutus* on the other; and between *Rubus argutus* and *Rubus frondosus* there exists a range of forms equally open to a double claim. Among the trailing species the lines of separation are even less effectively protected.

There would thus appear to be little room for new species in this group. Its units are established at such narrow intervals that the organic circumference of each undoubtedly invades that of one or more of the others. In many another genus of plants wherein the species move within a more contracted radius, differences far less pronounced than those which mark mere forms or states of our *Rubi* might be evidence enough of distinct organic type. The genus *Rubus*, however, would appear to represent the growing point of a genetic phylum subject to great variational activity and rapid and impermanent change and, not least to be considered, ready hybridization. In this view even wide variations in these plants are to be understood as the expression of a concentrated phylogenetic energy rather than as evidence of a completed organic segregation.

All of our species, however, show regional and local variations which, if unstable, are more or less obvious. For those who enjoy the exploitation of varieties here is a pristine field where their name is legion. For myself I have never yet been able to comprehend by what theory of differentiation the infinite varieties of plants are cast into two main categories—the to be named and the to be nameless. Not less among the blackberries than in many another group the accustomed eye finds varieties well marked for it everywhere, and moves freely out beyond the range of charted taxonomy not to be overtaken by any strained following of printed names. Shall we dare to hope, notwithstanding, that the foundations builded for this group by our forefathers may not ever be weighted by some crataegal structure which it is ill fitted to support? It has perhaps been thought that the genus *Rubus* was subject to an interpretation similar to that which has been unfolded in the genus *Crataegus*. To my observation there is an unmistakable failure of parallel between the composed and resistent, if often slight, differences between the species of *Crataegus* and the often

strongly expressed but weakly held variations scattered broadcast among the forms of *Rubus*.

My own study of this group, inadequate though it has been as a basis for assured conclusions, has led me notwithstanding, to make one addition to the number of our species. No need arises, however, for adding a new name to an already overburdened genus, for it seems possible with reasonable certainty to correlate this plant with the *Rubus flagellaris* of Willdenow, a trailing species allied to *Rubus procumbens*, which appears never to have been interpreted. This plant, which occurs on Nantucket and on Long Island, seems to possess the individuality of a true species and I have not been able to see how it can be accounted for as a hybrid. Furthermore it seems to be required as a parent of a series of Nantucket hybrids otherwise difficult or impossible to understand. This plant will be discussed in detail in another connection.

It is more than probable that some other species of eastern blackberries than those here accepted may yet come to light. In different parts of their ranges there is to be observed a perturbation among some of our hybrid forms which would seem to indicate either the influence of some unrecognized unit of species quality or else a process of intercrossing among primary hybrids very difficult to elucidate.

The wide fluctuations in the characters of all our blackberries under differing environments does not wholly obscure the fact that these variations in many cases take recognizable directions. It will doubtless ultimately be possible to define such tendencies with some approach to systematic form but, to use again the words of President Brainerd, it is to be hoped "that only experts—after years of study—will attempt it."

Specimens representing all the hybrids here proposed which have not already been described in detail as species will be deposited in the herbarium of the New York Botanical Garden. And it is intended that descriptions shall follow as opportunity may allow.

Current practice seems to require that the names of hybrid plants should bear the authority of the author by whom they were first proposed. It may be questioned whether by this usage the citation of an author's name is not a little overstrained. Unlike the case of a true species, the precise relationship and identity of a

hybrid plant is verifiable by experimental proof. Its name, formed from the combined names of its parents, comes into being automatically with the birth of the hybrid itself. It is not the creation of any author. And it may well be asked why its already compound structure should be further burdened with the name of an author by whom a certain one, possibly of many, forms of the hybrid was first made known.

No reason appears for instance why the author of the present paper should be cited as authority for the names of crosses which it becomes necessary here first to employ. Nevertheless, in order more certainly to divest the subject from all nomenclatorial claims in these pages and to allow the free treatment of a tabular presentation, I wish to be understood merely as pointing out the probability of the occurrence of the hybrids mentioned, not as announcing that they are known unmistakably to exist.

RUBUS CANADENSIS L.

R. elegantulus Bld.

R. amabilis Bld.

× ALLEGHENIENSIS: *R. ovarius* Bld. and *R. pergratus* Bld. so unite characters of *R. canadensis* and *R. allegheniensis* that a presumption of hybrid origin from those species seems unavoidable.

× NIGRICANS: *R. peculiaris* Bld. appears to belong here.

× HISPIDUS: *R. multiformis* Bld. may well be a form of this cross. Certain specimens of *R. vermontanus* Bld. are not to be separated from *R. multiformis*.

× BAILEYANUS: The characters of *R. recurvicaulis* Bld. would appear to point to its origin in the parentage here suggested.

× PROCUMBENS: *R. recurvicaulis*, var. *inarmatus* Bld., and *R. multiformis*, var. *delicatior* Bld., should be studied in the field with reference to their probable relationship with *R. canadensis* on the one hand and *R. procumbens* and *R. Enslenii* on the other.

In regard to *Rubus Randii* (Bailey) Rydb. there seems to be good reason to suppose that it is either a reduced form of *R. canadensis* or a hybrid of that species. I have not seen the type specimens but, judging from current labeling of botanical sheets, there would seem to be no definite conception among collectors of just

what the supposed species is or should be expected to be, and weak forms of a number of different blackberries have been referred to it. Among specimens so determined, spindling forms of *R. canadensis* are clearly to be recognized, and I have seen a few specimens of aberrant plants which actually suggested a cross between *R. canadensis* and *R. triflorus* Rich.

RUBUS ALLEGHENIENSIS Porter.

R. glandicaulis Bld.

× CANADENSIS: See under *R. canadensis.*

× ARGUTUS: Nantucket; Long Island.

× FRONDOSUS: Nantucket; Long Island.

× NIGRICANS: *R. frondisentis* Bld.

× HISPIDUS: *R. permixtus* Bld. *R. flavinanus* Bld. is perhaps a form of this cross or possibly a compound hybrid involving *R. nigricans, i. e., R. allegheniensis* × *vermontanus.*

× PROCUMBENS: Long Island.

× ENSLENII: *R. invisus* Bailey is possibly to be explained as a hybrid of these species. Certain herbarium specimens, presumably authentic, readily allow the suggestion, but, never having seen the living plant, I may altogether misunderstand it.

× BAILEYANUS: Long Island. *R. Jeckylanus* Bld. I think may be referred here.

Rubus sativus Brainerd, a name for which, I believe, President Brainerd through some misadventure of editor or printer was unintendedly on his part made to stand sponsor, represents a plant which I am inclined to regard as a weakened shade form of *R. allegheniensis* or perhaps some mixture of that species and *R. Baileyanus.*

RUBUS ARGUTUS Link.

R. floricomus Bld.

R. Andrewsianus Bld.

R. amnicolus Bld.

× ALLEGHENIENSIS: Nantucket; Long Island.

× FRONDOSUS: Nantucket; Long Island.

× NIGRICANS: *R. ascendens* Bld., in part. Nantucket; Long Island.

× HISPIDUS: Long Island.

× PROCUMBENS: Nantucket; Long Island.

× BAILEYANUS: Long Island.

× ENSLENII: Long Island.

× FLAGELLARIS: Nantucket.

× CUNEIFOLIUS: A plant collected at Tom's River, New Jersey, July 1, 1900, has every appearances of being this cross.

Rubus amnicolus, here placed with *R. argutus*, represents one of those intermediate variants between *R. allegheniensis* and *R. argutus* which, with equal reason, might be regarded as a form of either species. When copiously glandular their relationship to *R. allegheniensis* would scarcely be doubted; when glandless or nearly so they are not to be separated from racemose forms of *R. argutus*.

RUBUS FRONDOSUS Bigel.

R. recurvans Bld.

R. recurvans, var. *subrecurvans* Bld.

R. arundelanus Bld.

R. Rossbergianus Bld.

R. philadelphicus Bld.

× ALLEGHENIENSIS: Nantucket; Long Island.

× ARGUTUS: Nantucket; Long Island.

× NIGRICANS: *R. abbrevians* Bld. Nantucket; Long Island.

× HISPIDUS: Nantucket.

× PROCUMBENS: *R. multispinus* Bld. Nantucket; Long Island.

× BAILEYANUS: Nantucket; Long Island. *R. arenicolus* Bld. is very close to this hybrid.

× ENSLENII: Long Island.

× FLAGELLARIS: Nantucket.

RUBUS NIGRICANS Rydb.

R. vermontanus, var. *viridifolius* Bld.

R. jacens Bld.

R. tardatus Bld.

R. junceus Bld.

R. Groutianus Bld.

R. semisetosus Bld.

× CANADENSIS: *R. peculiaris* Bld.

× ALLEGHENIENSIS: *R. frondisentis* Bld.

× ARGUTUS: *R. ascendens* Bld., in part. Nantucket; Long Island.

× FRONDOSUS: *R. abbrevians* Bld. Nantucket; Long Island.

× HISPIDUS: *R. setosus* Bigel.; *R. vermontanus* Bld., in part; *R. trifrons* Bld.; *R. cubitans* Bld.; *R. hispidus*, var. *major* Bld. The plants described under these names are more or less intermediate between *R. nigricans* and *R. hispidus* and make up a group of connected forms showing the interplay among them of the same characters in slightly different combinations. *R. vermontanus* approaches very close to forms of *R. hispidus* × *procumbens*.

× PROCUMBENS: *R. semierectus* Bld. Long Island. *R. plicatifolius* Bld., although very dissimilar to *R. semierectus*, I am inclined to regard as a form of the same cross, perhaps a semi-pathological state.

× BAILEYANUS: Long Island.

× ENSLENII: Long Island.

× FLAGELLARIS: Nantucket.

RUBUS HISPIDUS L.

× CANADENSIS: *R. multiformis* Bld.

× ALLEGHENIENSIS: *R. permixtus* Bld.

× ARGUTUS: Long Island.

× FRONDOSUS: Nantucket.

× NIGRICANS: See under *R. nigricans*.

× PROCUMBENS: Nantucket.

× BAILEYANUS: Long Island.

× ENSLENII: Long Island.

× FLAGELLARIS: Nantucket.

RUBUS PROCUMBENS Muhl.

× CANADENSIS: See under *R. canadensis*.

× ALLEGHENIENSIS: Nantucket; Long Island.

× ARGUTUS: Nantucket; Long Island.

× FRONDOSUS: *R. multispinus* Bld. Nantucket; Long Island.

× NIGRICANS: *R. semierectus* Bld. *R. plicatifolius* Bld. Long Island.

× HISPIDUS: Nantucket.

× BAILEYANUS: *R. roribaccus* Bailey, which I find almost always associated with *R. procumbens* and *R. Baileyanus*,

appears to show no characters not derivable from one or the other of these species.

× ENSLENII: *R. geophilus* Bld., in part. Nantucket; Long Island.

× FLAGELLARIS: Nantucket.

RUBUS BAILEYANUS Britton.

× ALLEGHENIENSIS: *R. Jeckylanus* Bld. Long Island.

× ARGUTUS: Long Island.

× FRONDOSUS: *R. arenicolus* Bld. Nantucket; Long Island.

× NIGRICANS: Long Island.

× HISPIDUS: Long Island.

× PROCUMBENS: See under *R. procumbens*.

× ENSLENII: Nantucket; Long Island. *R. geophilus* Bld., in part.

× FLAGELLARIS: Nantucket.

RUBUS ENSLENII Trat.

R. subuniflorus Rydb., in part.

R. geophilus Bld., in part.

× ALLEGHENIENSIS: See under *R. alleghenienisis*.

× ARGUTUS: Long Island.

× FRONDOSUS: Long Island.

× NIGRICANS: Long Island.

× HISPIDUS: Long Island.

× PROCUMBENS: *R. geophilus* Bld. in part. Nantucket; Long Island.

× BAILEYANUS: Nantucket; Long Island.

× FLAGELLARIS: Nantucket.

RUBUS FLAGELLARIS Willd.

× ARGUTUS: Nantucket.

× FRONDOSUS: Nantucket.

× HISPIDUS: Nantucket.

× PROCUMBENS: Nantucket.

× BAILEYANUS: Nantucket.

× ENSLENII: Nantucket.

NEW YORK CITY.

A quantitative study of the more conspicuous vegetation of certain natural subdivisions of the coastal plain, as observed in traveling from Georgia to New York in July

ROLAND M. HARPER

In July, 1906, I made a zigzag journey from Georgia northeastward through the coastal plain, and after the botanical notes resulting therefrom had been digested so as to bring all the records of each species together, I prepared from them lists of plants which seemed to be common in all the states studied, and of some which were evidently more common in one state or region than in others, and also pointed out certain peculiarities of distribution of individual species. In the published account of this trip* some attention was paid also to general geographical features, aspects of vegetation, and plant habitats, but I did not do much in the way of defining natural geographical regions within the coastal plain, as the relations between vegetation and geology were not so evident in the Carolinas as in the states farther west.

Three years later I went through the coastal plain of the same states in the same direction, but by as different a route as possible, and afterward, instead of grouping my notes by species as before, I tried to determine the boundaries of the minor vegetation provinces that I had passed through, and then made a rough quantitative study † of the vegetation—or rather as much of it as could be identified from the car window—of each province.

On this second trip I started northward from Savannah on the afternoon of July 26, 1909, crossed the Savannah River into South Carolina about 33 miles out, and struck the fall-line at Columbia, about 140 miles due north of my starting-point. Remaining on the same train, I was then carried northeastward along or near the fall-line 106 miles, to Hamlet, North Carolina, but missed the last

*Bull. Torrey Club 34: 351–377. 1907.

†Most studies of vegetation in the past have been of an essentially qualitative nature, but quantitative work ought to be just as useful in phytogeography as it is in chemistry.

forty or fifty miles of scenery on account of darkness. From Hamlet early the next morning I walked back along the same route about a mile in order to study the sand-hill vegetation at close range. A little later I took the train for Wilmington, North Carolina's principal seaport, 110 miles away,* and after about an hour's wait there proceeded northeastward to New Bern,† 86 miles farther. On the twenty-eighth I went by the Norfolk & Southern Ry. up to Norfolk, Virginia, about 162 miles. The next day I went by the C. & O. Ry. from Newport News (just across Hampton Roads from Norfolk) to Richmond, 75 miles, and Doswell, 27 miles farther, then took the direct route to Washington. (Darkness came on about the time I reached the banks of the Potomac at Quantico, Va., the northern terminus of the R. F. & P. R. R.) On the afternoon of the thirtieth I went from Washington to Philadelphia by the Pennsylvania R. R., but without taking any notes, partly because the vegetation along that part of the route has been too much tampered with, and partly because it had been seen by so many botanists before. On the morning of the thirty-first I crossed the ferry to Camden, N. J., and went by rail directly east to the coast. Finally, after spending three days in the vicinity of Belmar and Tom's River with Dr. J. W. Harshberger, I went on to New York, through a thickly settled region in which no botanical notes of importance were obtained.

The route above described crossed that of 1906 at Fairfax, S. C., and Wilmington, N. C., and was tangent to it at Norfolk and Richmond. Except in the vicinity of these places the two routes were so far apart that in the present state of my knowledge of the geography of the Carolinas and Virginia I do not like to attempt much correlation between them; but in three of the regional lists below I have made use of my 1906 notes, in a manner to be explained.

*I traversed the first 32 miles of this, from Hamlet to Pembroke, in November, 1905, partly on foot. (See Torreya 6: 41–45. 1906). Although less than four years had elapsed, I could see that quite a number of changes had taken place along that part of the route. The population must have increased at least 10 per cent., and the natural vegetation suffered proportionately.

†The post-office authorities and some of the railroads print this name "Newbern," but the inhabitants of the city still prefer "New Bern," as attested by signs, legal documents, etc., and there does not seem to be any sufficient reason for disregarding their usage in the matter at present, although the simpler form may ultimately prevail.

In the following crude sketches of the regions passed through, the plants which I was able to identify in each are divided into trees, shrubs, and herbs, in my accustomed manner, and to each is prefixed the number of times it was noted from the train, with this modification: namely, wherever a species was very abundant (and so indicated in my field notes) I have counted it twice, just

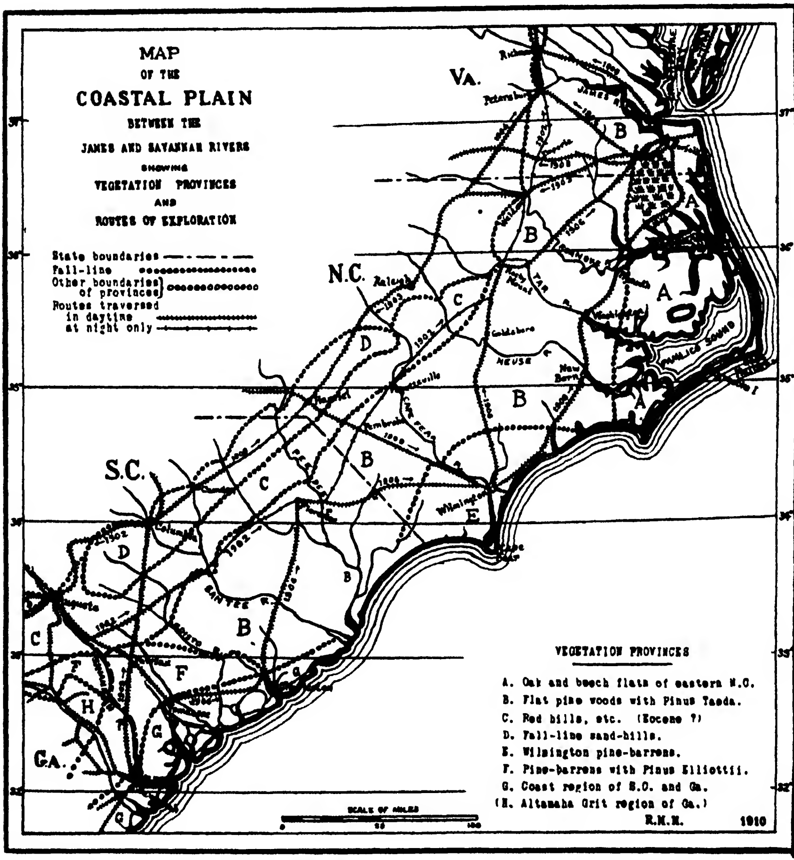

FIGURE 1. Map showing some of the vegetation provinces described herein, and the author's travels in the coastal plain between Virginia and Georgia from 1900 to 1909. Compiled from car-window notes and the maps of Kerr, Hammond, and others.

as if I had noted it twice between two consecutive mile-posts (as I might easily have done if I had been on a slower train). Species noted only once in a distance of 75 miles or less, or not more than twice in a distance of over 75 miles, are omitted.

As each list of course combines several habitats, I have not attempted to distinguish evergreens, vines, etc., as I sometimes do in treating habitat lists, but I have placed the names of weeds in parentheses, so as to make a little distinction between natural and unnatural vegetation. It is so difficult to estimate the effects of civilization on the relative abundance of native plants that I have left that phase of the problem almost untouched in this paper. Probably the most marked effect is the growing scarcity of long-leaf pine.

In my earlier paper already cited I referred to 68 works by other authors which bore more or less directly on the phyto-geography of the Carolina and Virginia coastal plain. Not much additional literature of that kind has appeared since, except a few more of the soil surveys of the U. S. Department of Agriculture. Under each region described I will mention a few of the more important references to it in previous publications, as I did not classify the literature by regions before.

That part of my route north of Savannah which lay in Georgia I had traversed once before (in June, 1903), but had never written anything about it. As I excluded it from the Altamaha Grit region in both of my published maps of Georgia* (though perhaps without sufficient reason) a superficial description of it will not be out of place here. It is mostly flat pine-barrens, with frequent gum swamps, and not many ponds. Only a small proportion of the area is under cultivation, but lumbering has greatly reduced the amount of *Pinus palustris*, as has been the case nearly through-out the range of that useful tree.

The plants noted are as follows:

TREES.

13 *Pinus serotina*
13 *Nyssa biflora*
11 *Pinus palustris*
10 *Pinus Elliottii*
9 *Liquidambar Styraciflua*
5 *Pinus Taeda*
4 *Magnolia glauca*
4 *Acer rubrum*
3 *Taxodium imbricarium*
2 *Liriodendron Tulipifera*
2 *Quercus falcata*

SHRUBS.

7 *Serenoa serrulata*
6 *Clethra alnifolia*
4 *Cliftonia monophylla*
4 *Quercus pumila*

*The frontispieces of Ann. N. Y. Acad. Sci., vol. 17, no. 1, 1906, and Southern Woodlands, vol. 1, no. 3, 1907.

6 *Myrica cerifera*
4 *Smilax laurifolia*
3 *Hypericum aspalathoides ?*
2 *Ilex glabra*

HERBS.

18 *Eupatorium rotundifolium*
7 *Tillandsia usneoides*
6 *Eriocaulon decangulare*
3 *Pluchea imbricata*
3 *Osmunda cinnamomea*
2 *Campulosus aromaticus*
2 *Rhexia Alifanus*
2 *Scirpus Eriophorum*
2 *Hibiscus aculeatus.*

(The flat pine-barrens of the southeastern part of the Altamaha Grit region, between Valdosta and Walthourville, Georgia, which I had studied in the same way a few days before, seem to have *Pinus Elliottii*, *Taxodium imbricarium*, *Ilex glabra*, and *Rhexia Alifanus* relatively more abundant, and *Pinus serotina*, *Eupatorium rotundifolium*, *Liquidambar*, *Pinus Taeda*, *Tillandsia*, and *Osmunda cinnamomea* perceptibly less so.)

Of the plants listed above, *Serenoa* and *Cliftonia* were not seen any more after leaving Georgia, this being just about the northern limit of both.

After crossing the Savannah River the railroad goes for about five miles through bottom-lands, in which *Liquidambar* and *Pinus Taeda* are the commonest trees and *Tillandsia usneoides* almost the only herb recognizable from the train. (It is hardly worth while to make a formal list of the plants seen in the ten or fifteen minutes it took to pass through these bottoms.)

The "rolling wire-grass country" of the Altamaha Grit region, which separates the lime-sink region from the flat pine-barrens all the way across Georgia, seems to terminate at or near the Savannah River, and the country just east of there in South Carolina appears to combine to a considerable extent the characters of those two regions which are so widely separated in Georgia and Florida. This part of South Carolina is a part of Hammond's "lower pine belt."* Its peculiarities are not easily pointed out, but it may be briefly described as a region of flat or nearly flat grassy pine-barrens with very little underbrush, and many shallow ponds. Its soil is probably a little more fertile than that of some other pine-barren regions, for there are more cultivated fields along this part of the route than I saw in the same distance south of the Savannah River.

*"South Carolina" 44–56. 1883; Tenth Census U. S. 6: 478–481. 1884.

In 1906 I passed through this region for a distance of 35 miles, between Allendale and Yemassee, and in 1909 I traversed it from about Garnett to Sycamore, a distance of some 28 miles; the two routes crossing at Fairfax, near its upper edge. In the following table the notes of the two trips are combined, but the figures are kept distinct, those for 1906 being given first in each case. As the dates were almost exactly the same in the two years there is no appreciable seasonal difference to be allowed for. The 1906 figures average somewhat smaller in this and the two other tables similarly constructed, probably because I did not watch the mile-posts as closely then as I did in 1909.

TREES

5+15	*Pinus Elliottii*	3+3	*Pinus Taeda*
8+10	*Taxodium imbricarium*	5+0	*Magnolia glauca*
9+4	*Pinus serotina*	1+2	*Liquidambar Styraciflua*
4+8	*Nyssa biflora*	1+2	*Quercus marylandica*
7+1	*Pinus palustris*	2+1	*Acer rubrum*
2+4	*Liriodendron Tulipifera*		

SHRUBS

8+6	*Clethra alnifolia*	0+2	(*Prunus angustifolia*)

HERBS.

1+12	*Eriocaulon decangulare*	0+3	*Pluchea bifrons*
1+10	*Eupatorium rotundifolium*	1+2	*Pontederia cordata*
3+8	*Oxypolis filiformis*	1+2	*Lespedeza capitata sericea*
4+6	*Polygala cymosa*	0+2	*Ludwigia pilosa*
2+4	*Zygadenus glaberrimus*	0+2	*Rhexia Alifanus*
3+2	*Tillandsia usneoides*	0+2	*Sabbatia decandra*
5+0	*Sarracenia flava*	1+1	*Osmunda cinnamomea*
2+2	*Anchistea virginica*	1+1	*Polygala ramosa*
0+4	*Scirpus Eriophorum*		

If I could have made this trip fifteen or twenty years earlier, when the railroad (then known as the South Bound R. R.) was new, *Pinus palustris* would doubtless have headed my list. Its present inferior rank here is due partly to lumbering operations, and partly to the fact that it occupied the driest soils, which were best suited to cultivation, while the trees that stand ahead of it in the above list all prefer wet places and have thus escaped destruction to a much greater extent.

Pinus Elliottii, *Pluchea bifrons*, *Ludwigia pilosa*, and *Sabbatia decandra*, all of which are typical, pine-barren pond plants, were not seen again after leaving Barnwell County, ponds being very

rare in the coastal plain farther north. A few of the other species seem to be more abundant in South Carolina than in any state farther north, probably for the same reason, as I have previously pointed out.*

The next 44 miles, from about the Salkehatchie River to the North Fork of the Edisto, were through a more hilly, less sandy, and more cultivated region, a continuation of the Eocene region of Georgia. In 1906 I passed through the same region for a similar distance in Aiken and Barnwell counties, between the Savannah River and Allendale. This part of South Carolina was included by Governor Drayton† in the "middle country," and described by Hammond‡ as the "upper pine belt" and "red hills." According to Hammond, in 1880 about 30 per cent. of the region was under cultivation, and over one third of that in cotton. (The proportion of cultivated land at the present time is probably at least 50 per cent.) The following list is made up from two sets of notes, in the same manner as the preceding.

TREES

10+21	*Pinus Taeda*	5+2	*Magnolia glauca*
8+20	*Pinus palustris*	1+4	*Cornus florida*
7+15	*Liriodendron Tulipifera*	4+0	*Salix nigra*
7+10	*Liquidambar Styraciflua*	0+3	*Quercus falcata*
1+9	*Nyssa biflora*	0+3	*Quercus marylandica*
2+7	*Quercus Catesbaei*	1+2	*Acer rubrum*
7+1	*Pinus serotina*	2+1	*Taxodium distichum*
4+3	*Taxodium imbricarium*	0+2	*Nyssa uniflora*

SHRUBS

2+3	(*Prunus angustifolia*)	2+2	*Myrica cerifera*
1+3	*Alnus rugosa*	0+3	(*Sassafras variifolium*)

HERBS

1+4	*Scirpus Eriophorum*	0+2	*Vernonia angustifolia*
0+4	*Eupatorium rotundifolium*	2+0	*Ludwigia suffruticosa*
4+0	*Tillandsia usneoides*	2+0	*Pontederia cordata*

This list contrasts with the preceding in many ways. The scarcity of (indigenous) visible herbs is striking. That seems to be characteristic of many originally well-wooded regions with vegetation approaching the climax, as compared with pine-barrens,

*Bull. Torrey Club 34: 364. 1907.

†A view of South Carolina 9–11. 1802.

‡"South Carolina" 71–116. 1883; Tenth Census U. S. 6: 481–488. 1884.

prairies, marshes, etc.* The abundance of *Pinus Taeda* also indicates the trend away from the typical pine-barren conditions which may be assumed to have existed here several thousand years ago. The frequency of *Pinus palustris* in a region with such characters is rather surprising, but that does not necessarily indicate that it is abundant. One tree of it on each side of the railroad every two or three miles would have been enough to give the above figures, 8 and 20.

The traveler going northward from Savannah would apparently here encounter *Cornus florida* and *Alnus rugosa* for the first time, but no species seem to have their northern limits in this belt.

On my route of 1909 the fall-line sand-hills begin in the upper edge of Orangeburg County, about 30 miles south of Columbia, and continue to Hamlet and beyond, interrupted only by the valleys of a few muddy rivers which rise in the Piedmont region. The sand-hill region is quite hilly, and nearly all the way through Lexington County one can get a splendid view to the eastward, clear across the valley of the Congaree River, and probably all the way to the "high hills of Santee."† Descriptions of this region can be found in nearly all general descriptions of South Carolina (which need not be specified here), but it is rarely mentioned in botanical literature. Only about 10 per cent. of the area was under cultivation in 1880, according to Hammond, but the proportion is of course considerably greater now.

The following list of plants is based on about 90 miles of observations in South Carolina, mostly in Lexington, Richland, and Kershaw counties, and 10 miles in Richmond and Scotland counties, North Carolina, besides what I saw in walking out a short distance from Hamlet. (On this walk of course I saw many plants that were too inconspicuous to be recognized from a train, but my rule of excluding species seen only once or twice in a region disposes of them.) The sand-hill plants belong principally to only two habitats, dry hills and bogs.

*In 1908 I found the same to be true on the Delaware peninsula, especially the southern half of it. (See Torreya 9: 222–223. 1909. With the weeds eliminated a similar state of affairs would have been evident in the other regional lists in the same paper.)

†See Drayton, View of S. C. 10. 1802; Hammond, "South Carolina" 110–111. 1883; Tenth Census U. S. 6: 486. 1884.

TREES

64 *Quercus Catesbaei*	7 *Liquidambar Styraciflua*
50 *Pinus palustris*	7 *Quercus cinerea*
18 *Nyssa biflora*	5 *Pinus echinata*
17 *Quercus marylandica*	4 *Magnolia glauca*
15 *Pinus Taeda*	3 *Populus deltoides* (along rivers)
13 *Liriodendron Tulipifera*	3 *Chamaecyparis thyoides*
8 *Cornus florida*	3 *Acer rubrum*
7 *Pinus serotina*	

SHRUBS

6 *Alnus rugosa*	3 *Clethra alnifolia*
4 *Polycodium caesium*	3 *Arundinaria tecta*
4 *Phoradendron flavescens*	3 (*Prunus angustifolia*)

HERBS

29 *Silphium compositum*	6 *Baptisia Serenae ?*
14 *Vernonia angustifolia*	5 *Pteris aquilina*
12 *Dasystoma pectinata*	4 *Osmunda cinnamomea*
12 *Eriogonum tomentosum*	4 *Carduus repandus*
10 *Eupatorium rotundifolium*	3 *Nolina georgiana*
6 *Angelica hirsuta*	

The frequency of *Pinus palustris* has of course been diminished by the same causes previously mentioned. About ten years ago, when that part of the Seaboard Air Line between Columbia and Hamlet had just been completed, this pine should have been seen nearly every mile, or about 100 times. Of the other plants associated with it here, *Polycodium*, *Eriogonum*, *Baptisia*, and *Nolina* were seen only in South Carolina on this trip, and they probably do not extend any farther north; while *Dasystoma pectinata*, *Carduus repandus*, and a few species seen less than three times were noticed a few miles over the state line in North Carolina, but no farther.

From about Laurel Hill to Rosindale, N. C., a distance of 63 miles, the country is mostly rather level, damp and sandy, with no ponds, but many shallow bogs and non-alluvial swamps, and a few pocosins toward the southeast. (The first few miles, and indeed most of Scotland County, is more hilly than the rest, and should perhaps be correlated with the parts of Orangeburg County, S. C., passed through the day before, but the hilly part is so limited that it will not introduce any serious error to include it with the rest.) This kind of country, with slight modifications, seems to extend southeastward most of the way across South Carolina,

but not into Georgia. It has been described by Kerr* and by Ashe,† but they did not clearly indicate its boundaries, and it is indeed difficult to do so. A pretty good description of a part of it is the U. S. soil survey of Robeson County, by W. E. Hearn and others, published in October, 1909.

Pinus Taeda is the prevailing tree, this being far out of the range of *P. Elliottii*, which occupies somewhat similar habitats farther south. The woods are mostly rather open, with a herbaceous vegetation much like that of regular pine-barrens. While traversing this region on July 27, 1909, my observations were hindered somewhat by frequent showers, but the following list is probably representative enough.

TREES

47 *Pinus Taeda*
25 *Nyssa biflora*
17 *Quercus marylandica*
15 *Liquidambar Styraciflua*
15 *Acer rubrum*
14 *Pinus palustris*
12 *Pinus serotina*
11 *Taxodium imbricarium*
10 *Cornus florida*
10 *Magnolia glauca*
10 *Quercus falcata*
8 *Liriodendron Tulipifera*
5 *Salix nigra*
4 *Quercus Catesbaei*
3 *Taxodium distichum*
2 *Nyssa uniflora*

SHRUBS

9 *Clethra alnifolia*
5 *Cyrilla racemiflora*
4 *Alnus rugosa*
3 (*Sassafras variifolium*)
3 *Myrica cerifera*
3 *Smilax laurifolia*

HERBS

35 *Eupatorium rotundifolium*
24 *Sarracenia flava*
8 *Habenaria blephariglottis*
7 *Marshallia graminifolia*
6 *Polygala ramosa*
6 *Vernonia angustifolia*
6 *Nymphaea sagittifolia*
5 *Eriocaulon decangulare*
5 *Polygala lutea*
4 *Lespedeza capitata sericea*
4 *Osmunda cinnamomea*
3 *Rhexia Alifanus*
3 *Zygadenus glaberrimus*
3 (*Helenium tenuifolium*)
2 *Afzelia cassioides*
2 *Scirpus Eriophorum*
2 *Chondrophora nudata*
2 *Sabbatia lanceolata*
2 (*Leptilon canadense*)
2 *Baldwinia uniflora*
2 *Xyris* sp.

Sarracenia flava, which was not seen at all between Savannah and Hamlet, here occurs in abundance. *Marshallia graminifolia* likewise appears in this list for the first time. A few of the rarer plants will be mentioned more particularly in a subsequent paper.

*Tenth Census U. S., vol. 6. 1884.
†N. C. Geol. Surv. Bull. 5 and 6. 1894 and 1898.

Extending out from Wilmington in all directions (that is, on the land side) for thirty or forty miles is a most interesting area of genuine pine-barrens, long noted for being the home of *Dionaea muscipula* and several other local species. In general this region is nearly level, except near some of the streams, where the topography somewhat resembles that of the Altamaha Grit region of Georgia. Pocosins* are frequent, savannas are occasional, and lakes and ponds are rare or wanting. There seems to be no marked difference in topography or soil between this region and the preceding, and they intergrade over a zone perhaps ten miles wide. This and other circumstances seem to indicate that the boundary is determined by succession of vegetation more than anything else, that the pine-barrens were formerly more extensive, and that the short-leaf pine forests are tending to close in on them and will ultimately "wipe them off the map" (that is, if man does not do so first, which is more likely).

The Wilmington or Cape Fear pine-barren region as here treated coincides almost exactly with that part of eastern North Carolina in which according to Kerr† less than one tenth of one per cent. of the area was cultivated in cotton in 1880. Descriptions of it have been published by Emmons, Kerr, Ashe, and others, and pretty good floras of parts of it by Curtis in 1835 and Wood & McCarthy in 1887.‡ The U. S. soil survey of New Hanover County, by Drake & Belden (February, 1907) covers the very focus of it, and Circular 20 of the Bureau of Soils, by H. H. Bennett (January, 1910) contains a preliminary report on the soils and some other geographical features of Pender County.§

*See Bull. Torrey Club **34**: 361–362. 1907; also C. A. Davis, N. C. Geol. Surv. Econ. Paper 15: 149–150. 1910 (erroneously dated 1908).

†Tenth Census U. S., vol. 6, map 13.

‡For more complete references to these works see my 1907 paper.

§It is probably something more than a mere coincidence that the summers are a little wetter in this Cape Fear region than in adjoining regions or in many places where the native vegetation more nearly approaches the climax condition and there is more land under cultivation. At Wilmington, according to the latest statistics I have been able to obtain, 49.4 per cent. of the total annual precipitation occurs in the four warmest months, June to September, inclusive.

For a number of other places in the coastal plain within a few hundred miles of Wilmington the same factor is somewhat lower, as follows:—Norfolk, Va., 40 per cent.; Tarboro, N. C., 41.0; Goldsboro, N. C., 43.6; New Bern, N. C., 45.2; Cape Hatteras (one of the rainiest places in the Eastern Unites States outside of the moun-

In 1906 I passed through this region from about Lake Waccamaw to Wilmington, 36 miles, and from Wilmington to the northern boundary of Pender County, 35 miles; and in 1909 from Rosindale to Wilmington, 37 miles, and Wilmington to Verona, 43 miles. The following list of plants has been compiled from the notes of both trips in the manner previously described. In my account of the first trip * I gave a systematic list of species which seemed to be more abundant near Wilmington than in some other places. As might have been expected, the present list, which shows approximately the relative abundance of some of the more conspicuous plants in the Cape Fear region, contains many of the same species, though the two lists are by no means identical.

TREES

18+53	*Pinus palustris*	2+12	*Taxodium imbricarium*
17+40	*Pinus serotina*	7+7	*Taxodium distichum*
12+26	*Magnolia glauca*†	4+7	*Quercus marylandica*
1+27	*Gordonia Lasianthus*	5+6	*Liriodendron Tulipifera*
13+15	*Pinus Taeda*	0+9	*Acer rubrum*
3+22	*Nyssa biflora*	1+8	*Quercus falcata*
5+20	*Quercus Catesbaei*	0+3	*Persea pubescens*
3+12	*Cornus florida*	2+1	*Quercus cinerea*
6+9	*Liquidambar Styraciflua*		

SHRUBS

12+20	*Clethra alnifolia*	6+10	*Myrica cerifera*
4+27	*Smilax laurifolia*	2+10	*Ilex glabra*
7+20	*Cyrilla racemiflora*	1+4	*Phoradendron flavescens*
3+15	*Myrica pumila*	2+2	*Amorpha herbacea*

HERBS

19+31	*Sarracenia flava*	3+3	*Chondrophora nudata*
9+22	*Aristida stricta*	3+3	*Tillandsia usneoides*

tains), 35.8; Lumberton, N. C., 41.2; Florence, S. C., 46.1; Statesburg, S. C., 41.7; Blackville, S. C., 42.5; St. George, S. C., 47.8; Altamaha Grit region of Georgia, 43.9 per cent. The Piedmont region seems to have about 35 per cent. of its annual rainfall in these four months.

Mere distance from the coast does not seem to have much to do with these figures, as shown by the great difference between those for Wilmington and Cape Hatteras. Latitude and altitude are probably equally inadequate to explain the variation. In general a heavy summer rainfall (in Eastern North America at least) seems to correspond approximately with pioneer vegetation, such as open pine forests. But this seasonal distribution of precipitation could hardly be considered the sole cause of the condition of the vegetation, for that can often be correlated with soil and geological history. May not this type of rainfall then perhaps be partly the effect rather than the cause of pioneer vegetation?

*Bull. Torrey Club **34**: 365. 1907.

†Often only a shrub.

8+22	*Eriocaulon decangulare*	3+3	*Dichromena latifolia*
17+10	*Rhexia Alifanus*	0+5	*Oxypolis filiformis*
13+13	*Polygala lutea*	1+4	*Osmunda cinnamomea*
8+13	*Eupatorium rotundifolium*	2+3	(*Acanthospermum australe*)
0+17	*Trilisa odoratissima*	2+3	*Vernonia angustifolia*
5+11	*Zygadenus glaberrimus*	3+2	*Tofieldia racemosa*
9+6	*Polygala ramosa*	3+2	*Xyris* sp.*
3+8	*Marshallia graminifolia*	1+3	*Pteris aquilina*
10+0	*Campulosus aromaticus*	1+3	*Scirpus Eriophorum*
2+5	*Sabbatia lanceolata*	2+2	*Pontederia cordata*
2+5	(*Helenium tenuifolium*)	1+2	*Polygala cymosa*
4+3	*Lilium Catesbaei*	1+2	*Silphium compositum*
2+4	*Habenaria blephariglottis*		

Rhexia Alifanus, *Polygala ramosa*, *Campulosus aromaticus*, and *Lilium Catesbaei* were seen oftener along my 1906 route through this region than on that of 1909, and *Gordonia*, *Nyssa biflora*, *Quercus Catesbaei*, *Cornus florida*, *Taxodium imbricarium*, *Acer rubrum*, *Quercus falcata*, *Smilax laurifolia*, *Myrica pumila*, *Ilex glabra*, *Phoradendron*, *Trilisa*, *Oxypolis*, and *Osmunda cinnamomea* at least four times as often on the second trip as on the first, which seems rather singular. Some of these cases may be due simply to my own carelessness, but others probably indicate local irregularities of distribution. Other evidence of such irregularities is found in the fact that in each year I noted several fairly abundant species in this region either on one side or the other of Wilmington and not on both. It would be very interesting if some other botanist would go through the same region at the same season, either by one of the same routes or by a different combination of routes (Wilmington has five lines of railroad radiating from it, all passing through the pine-barrens for approximately the same distance), and take notes in the same way and compare his results with the above.

It happens that all the species here recorded from the Cape Fear pine-barrens occur also in Georgia† (and with approximately the same relative frequency), while several of them, such as *Gordonia*, *Persea*, *Cyrilla*, *Myrica pumila*, *Amorpha*, *Aristida stricta*,

*Probably *X. flexuosa* (*X. torta* of many authors) and one or two others.

†From which it follows that the local species peculiar to this region are either rare, or inconspicuous in midsummer (or both), or else that I do not know them well enough to recognize them from a moving train.

Polygala lutea, Trilisa, Sabbatia lanceolata, Habenaria blephariglottis, and *Chondrophora*, were not seen at all in South Carolina, in either year, and a number of others seem to be rare in that state. In this connection it is extremely interesting to note that on Dr. Hilgard's agricultural map of the southeastern states* (which by the way is undoubtedly the best vegetation map of that part of the country ever published), he assigned the Cape Fear pine-barrens to the same subdivision as the Altamaha Grit region of Georgia (together with certain parts of other states), but skipped South Carolina with this subdivision entirely. This idea of Dr. Hilgard's is all the more remarkable when one observes that the agricultural maps of the individual states involved (in the sixth volume of the same series) give scarcely a hint of this state of affairs.†

Quercus Catesbaei, Q. cinerea, Marshallia, Chondrophora, Oxypolis, Vernonia, Tofieldia, and *Polygala cymosa* were not seen any more after leaving the pine-barrens, and three of these, the *Marshallia, Oxypolis*, and *Polygala*, were not even seen northeast of Wilmington. All except the *Marshallia* and *Vernonia* are known or supposed to extend considerably farther north, but they cannot be very common along the route that I traveled from Wilmington to New York.

On reaching the banks of the estuary of New River in Onslow County, half way between Wilmington and New Bern, I left the pine-barrens behind. From there to Mackey's Ferry on Albemarle Sound, a distance of about 122 miles, I was in a country very similar in most respects to that between Laurel Hill and Rosindale in the same state, and probably connected with it, but with certain differences in vegetation which I am not quite prepared to explain. This part of the journey should perhaps be subdivided further, for low hills with hammock-like vegetation were‡ fre-

*The first map in the fifth volume of the Tenth Census reports.

†Another interesting fact in this connection is that Dr. Eugene A. Smith about the same time published a map of similar import (the first map in the fourth report of the U. S. Entomological Commission), based on essentially the same data, which combines the various kinds of pine-barrens under one color, making no distinction between those of South Carolina and other states; but this may be due only to the fact that this map is smaller and does not attempt to show so much detail.

‡I once supposed (see Science II. 22: 401. 1905) that the term "hammock" was used in North Carolina, but the only evidence I had (U. S. Geol. Surv. Bull.

quent in some places and pocosins (almost the other extreme) in others; but for the present I can do no better than treat it as a unit. Three or four estuaries were crossed in this distance, but most of the plants characteristic of their marshes were not seen often enough to be included in the following list.

A considerable part of this region is described in the U. S. soil survey of the "Craven area," by Smith and Coffey, published in January, 1905. Important botanical papers on the same region have been published by Croom* and by McCarthy.† The railroad between New Bern and Washington, a distance of about 35 miles, had been in operation only a year or two, so that I found the vegetation along there more nearly in a natural condition than in most other parts of this journey.

The plant list for these 122 miles is as follows:

TREES

104	*Pinus Taeda*	12	*Quercus marylandica*
71	*Liquidambar Styraciflua*	10	*Taxodium distichum*
57	*Nyssa biflora*	9	*Quercus alba*
35	*Cornus florida*	8	*Salix nigra*
27	*Pinus serotina*	7	*Fagus grandifolia*
26	*Magnolia glauca*	7	*Gordonia Lasianthus*
25	*Oxydendron arboreum*	5	*Ilex opaca*
24	*Pinus palustris*	4	*Quercus Phellos*
19	*Acer rubrum*	3	*Nyssa uniflora*
18	*Liriodendron Tulipifera*	3	*Taxodium imbricarium*
15	*Quercus falcata*	3	*Quercus stellata*

SHRUBS

23	*Myrica cerifera*	11	*Clethra alnifolia*
21	*Cyrilla racemiflora*	6	*Phoradendron flavescens*
13	*Ilex glabra*	5	*Aralia spinosa*
12	*Alnus rugosa*	3	*Pieris nitida*
12	*Smilax laurifolia*	3	*Decodon verticillatus*
12	*Arundinaria tecta*		

HERBS

23	*Eupatorium rotundifolium*	5	*Rhexia Alifanus*
18	*Sarracenia flava*	5	*Osmunda cinnamomea*
10	*Habenaria blephariglottis*	5	*Polygala ramosa*
9	*Tillandsia usneoides*	4	*Xyris* sp.

84: 72. 1892) was its use by a man who had seen hammocks in the states farther south, so that it may not have been really indigenous to that locality (the "natural well" of Duplin County).

*A catalogue of plants . . . in the vicinity of New Bern, . . . 1837.

†Bot. Gaz. 10: 384, 385. 1885; 12: 76–78. 1887.

8 (*Rynchospora inexpansa*)	4 (*Senecio tomentosus*)
7 *Aristida stricta*	4 (*Leptilon canadense*)
7 *Polygala lutea*	3 *Sabbatia lanceolata*
6 *Eriocaulon decangulare*	3 *Pontederia cordata*

Pinus echinata must have once occurred in this region, according to Pinchot & Ashe,* but I did not see any of it. *Oxydendron*, *Quercus alba*, *Fagus*, *Ilex opaca*, and *Senecio tomentosus* make their first appearance in this list, and *Cornus florida*, *Taxodium distichum*, *Quercus Phellos*, *Myrica cerifera*, *Aralia spinosa*, and *Rynchospora inexpansa* are decidedly more frequent here than in most of the preceding lists. (Most of the twelve species last mentioned seem to be still more common in southeastern Virginia.†) On the other hand, *Pinus palustris*, *Gordonia*, *Taxodium imbricarium*, *Cyrilla*, *Ilex glabra*, *Clethra*, *Pieris*, *Sarracenia*, *Tillandsia*, *Aristida*, *Rhexia Alifanus*, *Polygala ramosa*, and *Sabbatia lanceolata* (as well as several equally interesting species noted less than three times and therefore not listed here) were now seen for the last time. Nearly all of these last are known or supposed to extend at least a short distance into Virginia, west of Dismal Swamp, but the rest of my route to Norfolk lay farther east.

From Mackey's Ferry the cars were taken across Albemarle Sound (and the 36th parallel) to Edenton, the county-seat of Chowan County, on a nine-mile ferry (since superseded by a trestle). From about this point what Prof. Shaler termed the Nansemond escarpment‡ extends northward past the western edge of Dismal Swamp to the vicinity of Suffolk, Va. From Edenton to Norfolk, 73 miles, I was east of this escarpment all the way, skirting the eastern edge of the swamp, and passing though a region quite different from anything else seen on this trip. It is rather flat, with prevailingly loamy or even silty soil, quite different from the sandy soil that prevails at corresponding distances from the coast most of the way from New York to New Orleans. There are many shallow swamps but apparently no ponds. The uplands, or drier spots, were nearly all cleared and cultivated long

*N. C. Geol. Surv. Bull. 6: 130, 150. 1898.

†See Bull. Torrey Club **34**: 366. 1907; Torreya **9**: 223, 224. 1909.

‡Ann. Rep. U. S. Geol. Surv. 10[1]: 314, 317, 326–331. *pl. 6, 12–14. f. 28, 34–36.* 1890. See also Kearney, Contr. U. S. Nat. Herb. **5**: 332. 1901.

ago,* so that not much is left of their original vegetation. In topography, soil, vegetation, proportion of cleared land, and a few other features, this region strikingly resembles some river-bottoms farther south, particularly in the Cretaceous region of Georgia and Alabama.†

This region was mapped by Kerr in 1884‡ as the "oak and beech flats with short-leaf pine," and parts of it have since been described by Shaler in the work just cited, by Kearney in his well-known Dismal Swamp report, by Darton in the "Norfolk folio" of the U. S. Geological Survey,§ and by J. E. Lapham and others in the government soil surveys of the "Norfolk area," Virginia, and Pasquotank, Perquimans, and Chowan counties, North Carolina.

The plants observed between Edenton and Norfolk are as follows:

TREES

39 *Pinus Taeda*	8 *Nyssa uniflora*
37 *Liquidambar Styraciflua*	6 *Cornus florida*
16 *Taxodium distichum*	5 *Liriodendron Tulipifera*
12 *Acer rubrum*	5 *Magnolia glauca*
11 *Fagus grandifolia*	4 *Quercus Phellos*
9 *Nyssa biflora*	3 *Quercus falcata*
9 *Salix nigra*	3 *Quercus alba*
9 *Pinus serotina*	3 *Oxydendron arboreum*

SHRUBS

17 *Arundinaria tecta*	4 *Phoradendron flavescens*
12 *Myrica cerifera*	2 *Aralia spinosa*
8 *Alnus rugosa*	2 *Smilax laurifolia*
6 *Rhus copallina*	

*The earliest permanent settlements in North Carolina were made in this very region about 260 years ago.

†Prof. Collier Cobb, in his North Carolina supplement to Redway & Hinman's Natural Advanced Geography, states that the first settlers were attracted to this region by the "magnificent bottom land," among other things. (He tells me that this quotation is from pages xxi–xxii of the prefatory notes to vol. 1 of the Colonial Records of North Carolina, by Col. Wm. L. Saunders.)

‡Tenth Census U. S., vol. 6, map 12.

§Geologic Atlas of the U. S., Folio no. 80. 1902. Unlike most of the earlier folios of this series, this one contains several excellent illustrations of the vegetation and other scenery (which Mr. Darton tells me are from photographs taken by the late Prof. I. C. Russell). Some of the same pictures were used before in the reports of Shaler and Kearney already cited, and some have appeared more recently in various semipopular magazines, mostly in connection with articles advocating the annihilation of swamps.

HERBS

13 (*Senecio tomentosus*)
7 *Eupatorium rotundifolium*
6 *Anchistea virginica*
5 (*Daucus Carota*)
5 *Scirpus Eriophorum*
4 (*Rynchospora inexpansa*)
3 (*Ambrosia artemisiifolia*)
3 *Typha latifolia*
3 *Habenaria blephariglottis*
2 *Pontederia cordata*
2 *Saururus cernuus*
2 *Pteris aquilina*
2 (*Oenothera biennis*)
2 *Nymphaea advena*
2 *Sabbatia angularis**

Many of the above species are especially characteristic of bottom-lands. But *Acer rubrum*, *Pinus serotina*, *Magnolia glauca*, *Smilax laurifolia*, *Eupatorium rotundifolium*, *Anchistea*, and *Habenaria* indicate occasional sandy bog conditions, perhaps connected with prongs of the Dismal Swamp.

The only plants in this list that had not been seen farther south are *Daucus Carota* and *Saururus cernuus*. The former, a well-known weed, appeared commoner than any native herb all the way from the southern boundary of Virginia to New York, except in the New Jersey pine-barrens. *Pinus serotina*, *Arundinaria*,† *Phoradendron*, *Senecio tomentosus*, *Rynchospora inexpansa*, and a few species noted only once and therefore not mentioned here, were not seen north of Norfolk.

From Newport News on the coast (in latitude 37°) to Richmond at the fall-line, a distance of 75 miles, the country is moderately undulating (with considerable bluffs along some of the estuaries), the soil rather loamy, and the forests comparatively dense, with no suggestion of pine-barrens. The proportion of cleared land was less than I expected to find along a railroad 28 years old, in a region that has been settled for 300 years,‡ but perhaps very little of the forest is primeval.

A considerable portion of this peninsula between the York and James rivers has been described by Burke & Root in their soil survey of the "Yorktown area," published in April, 1907. There are few direct references to this part of Virginia in botanical

*Seen only near the second mile-post north of Northwest, Va., which is pretty close to the only station recorded for it by Mr. Kearney.

†Several years ago I saw this from the Pennsylvania R. R. at a point between Washington and Baltimore which Dr. Forrest Shreve tells me is the only known station for it in Maryland. On this trip I looked for it again there but did not happen to see it.

‡My route passed within six miles of Jamestown and still nearer to Yorktown.

literature, though Clayton probably explored the territory pretty thoroughly in the eighteenth century,* and a few plants were collected near Mobjack Bay, a little farther east, in the nineteenth century.†

The following list of plants will give some idea of the general appearance of the vegetation at the present time.

TREES

41 *Pinus Taeda*
28 *Liquidambar Styraciflua*
19 *Liriodendron Tulipifera*
19 *Cornus florida*
18 *Quercus alba*
18 *Pinus virginiana*
13 *Acer rubrum*
12 *Fagus grandifolia*
11 *Pinus echinata*
10 *Quercus falcata*
9 *Quercus Phellos*
6 *Nyssa biflora ?*
6 *Salix nigra*
4 *Oxydendron arboreum*
3 *Taxodium distichum*
2 *Quercus marylandica*
2 *Nyssa uniflora*

SHRUBS

7 *Myrica cerifera*
3 (*Sassafras variifolium*)
2 *Alnus rugosa*

HERBS

9 (*Daucus Carota*)
3 *Pteris aquilina*
2 *Eupatorium purpureum*
2 *Nymphaea advena*

Trees are here much more numerous than conspicuous herbs, doubtless for the same reason as in the "middle districts" or "upper pine belt" of South Carolina, described a few pages back. The only new element in this list is *Pinus virginiana*, but that comes in rather suddenly, immediately taking its place considerably above the middle of the list.‡ *Oxydendron*, *Taxodium* and *Myrica* appear here for the last time. They all extend somewhat farther north, but only in the coastal plain, and after passing Richmond I kept too close to the fall-line to see them until I got entirely beyond their northern limits. This vegetation is naturally very similar to that of the Delaware peninsula, which I had examined in the same superficial way about a year before.§

I had about three hours to wait in Richmond, and while strolling about the city I was surprised to see "cut flowers" of *Polygala lutea*, *Sabbatia lanceolata*, and *Habenaria ciliaris*, typical pine-

*See Barnhart, Torreya 9: 242. 1909

†See Leggett, Bull. Torrey Club 6: 48–49. 1875.

‡See Torreya 9: 226. 1909.

§See Torreya 9: 221–223. 1909.

barren bog plants, together with those of *Daucus Carota* and perhaps a few others, offered for sale in the markets by negro women. I had never found the first two myself within many miles of Richmond, but one would not suppose they had been brought very far for such a purpose, and it would be interesting to learn just where they did grow.

From Richmond to Doswell (*via* Hanover) my route was within a few miles of the fall-line, and from Doswell to Philadelphia it would seem from a small-scale map to be right on the fall-line, but in reality the coastal plain sediments overlap the metamorphic rocks a little all along here, so that the latter were hardly ever visible except on the banks of rivers. It will be safe enough therefore to regard the vegetation along this route as belonging to the coastal plain, as I did in the fall-line sand-hills of the Carolinas.

Some botanical notes made along very nearly the same route have been published by Prof. L. F. Ward.* The soil survey of Hanover County, Virginia, by Bennett and McLendon, published in May, 1907, covers a small part of it.

It is 84 miles, the way I went, from Richmond to Quantico, where I stopped taking notes on account of darkness. In this distance the following plants were noted.

TREES

30 *Pinus Taeda*	11 *Pinus echinata*
26 *Pinus virginiana*	9 *Quercus Phellos*
35 *Liquidambar Styraciflua*	7 *Fagus grandifolia*
16 *Liriodendron Tulipifera*	5 *Quercus palustris*
14 *Acer rubrum*	5 *Quercus falcata*
14 *Quercus alba*	4 *Platanus occidentalis*
13 *Betula nigra*	3 *Quercus stellata*
13 *Cornus florida*	3 (*Robinia Pseudo-Acacia*)
11 *Salix nigra*	

SHRUBS

18 *Alnus rugosa*	3 *Cephalanthus occidentalis*
9 (*Sassafras variifolium*)	

HERBS

12 (*Daucus Carota*)	6 *Pteris aquilina*
7 *Scirpus cyperinus ?*	3 *Nelumbo lutea*

Quercus palustris and *Robinia* here appear for the first time (the latter introduced), *Betula nigra* and *Nelumbo* for the

*Bot. Gaz. 11: 32–38. 1886.

only time, and *Pinus Taeda*, *Salix nigra*, *Liriodendron*, *Fagus*, and *Platanus* for the last time; but perhaps no special significance is to be attached to any of these facts. Practically all the species in the list are common both in the coastal plain and in the Piedmont region, as might have been expected, and trees are much more numerous than conspicuous herbs, for the same reason as before.

Skipping Maryland, Delaware, and Pennsylvania, for the reasons already given, we now come to New Jersey. From Camden to South Pemberton, a distance of 25 miles, I was in the Cretaceous region, which differs in no essential particular from the corresponding portions of Delaware, which I had traversed in the same manner and for approximately the same distance the year before.* Parts of it lying north and south of my route were described several years ago in the United States soil surveys of the Trenton and Salem areas, New Jersey. This region is so thickly settled that it is difficult to form an adequate idea of its original vegetation. The following pitiful remnants (and introduced weeds) were noticed.

TREES

3 *Acer rubrum*
3 *Castanea dentata*
3 (*Robinia Pseudo-Acacia*)
2 *Liquidambar Styraciflua*
2 *Quercus alba*
2 *Pinus virginiana*

SHRUBS

3 *Alnus rugosa*

HERBS

5 (*Daucus Carota*)
2 *Pteris aquilina*
2 *Nymphaea advena*
2 (*Trifolium arvense*)
2 (*Achillea Millefolium*)

Castanea dentata appears in this list only, and it happens that on my way southward the year before I saw it only in approximately the same kind of country in Delaware.

I traversed the celebrated pine-barrens of New Jersey for a distance of 31 miles, from South Pemberton to Barnegat Pier, where the salt-water vegetation begins. The papers bearing on this region are too numerous (and mostly too short) to be men-

*See Torreya 9: 219–221. 1909.

tioned in such a rudimentary description as this, but interested readers can easily find them.*

The plants which I was able to recognize more than once in this region are as follows.

TREES

34 *Pinus rigida*	3 *Quercus marylandica*
8 *Chamaecyparis thyoides*	3 *Quercus Prinus*
7 *Pinus echinata*	2 *Nyssa sylvatica ?*
4 *Betula populifolia*	2 *Quercus alba*
3 *Acer rubrum*	

SHRUBS

16 *Quercus ilicifolia*	2 (*Sassafras variifolium*)
2 *Comptonia peregrina*	

HERBS

19 *Pteris aquilina*	3 *Osmunda cinnamomea*
4 *Anchistea virginica*	2 *Habenaria blephariglottis*
4 *Lilium superbum*	2 *Lophiola aurea*

The species appearing for the first time in this list are *Pinus rigida*, *Quercus Prinus*, *Q. ilicifolia*, *Comptonia*, *Lilium superbum*, and *Lophiola*.

In botanical manuals one frequently sees the ranges of certain plants given as "Pine-barrens, New Jersey to Florida," etc., just as if the same kind of country extended all the way. But on this trip it was strongly impressed on me that the New Jersey pine-barrens are quite different from the southern ones. The two kinds do not even intergrade, for one can travel the whole length of the Delaware peninsula, from the fall-line to the coast, without seeing any pine-barrens of either kind.†

The differences between northern and southern pine-barrens seem to be more numerous than the similarities. Considering only characters observable from a train, the similarities are about as follows. Both are in the coastal plain and have sandy soil, with pioneer vegetation subject to frequent fires. Pines are the dominant trees, and oaks usually form a sort of lower story. Sour bogs and swamps are frequent. Both regions are comparatively thinly settled, and still have more forests than fields.

*There is however one work that deserves special mention, namely, the report on forests that accompanied the annual report of the state geologist of New Jersey for 1899. This is a volume of 327 pages, containing important contributions by Vermeule, Pinchot, Hollick, Gifford, and others, together with numerous maps and illustrations.

†See Torreya 9: 217, 218. 1909. Shreve, Plant life of Maryland 85–88. 1910.

Some of the differences are: The sand is coarser in New Jersey, and there seems to be no clay subsoil, and no ponds. The dominant pines and oaks are different (and the range of *Pinus rigida* does not even overlap that of *P. palustris*, and still less that of *P. Elliottii*). Shrubs are much more abundant (in individuals, not necessarily in species) in New Jersey, and herbs, especially grasses, correspondingly sparse. The southern pines are among the most valuable trees we have, while the northern ones are small and crooked, and even if they were larger they would be of little use except for fuel. *Chamaecyparis* is commoner in New Jersey than it is in pine-barrens of any other state.

The New Jersey pine-barrens probably find their nearest counterpart in those of Long Island, which I described about two years ago.* The principal difference is that those of New Jersey have more bogs to the square mile, and a richer flora even in the dry pine-barrens. New Jersey seems to have all the pine-barren plants that Long Island has, and several more besides. Of those listed above, *Pinus echinata* and *Lophiola* are not known on Long Island, while *Chamaecyparis*, *Quercus marylandica*, *Q. Prinus*, *Lilium*, and *Habenaria* do grow on the island but apparently not in the pine-barrens thereof.

On the whole trip from Savannah to Barnegat Pier, which involved about 775 miles of note-taking, the number of species of plants seen from the train (this excludes about 25 species which I saw only near Hamlet, as above explained) was about 220. Of these 61 were seen in Georgia, 103 in South Carolina, 135 in North Carolina, 70 in Virginia, and 50 in New Jersey. (The diversity of these figures of course depends more on the different distances traveled in each state than anything else, for the number of species seen on any route is probably approximately proportional to the square root of the distance, when other things are equal.)

About 100 of these plants were not seen often enough in any one region to be mentioned in this paper. Of those that are mentioned by name, 3 are ferns, 10 conifers, 22 monocotyledons and 88 dicotyledons; but ten or twelve of the dicotyledons are weeds. Some generalizations with respect to the distribution of the remaining 112 native species may be of interest.

*Torreya 8: 1–9. 1908.

Nearly 37 per cent. are confined to the coastal plain, as far as known, while 32 per cent. extend into the adjacent Piedmont region (several of them even to the mountains), but not into the glaciated region. About 4.5 per cent are common to the glaciated region and coastal plain and not known elsewhere, while a little over 26 per cent. are rather widely distributed in Eastern North America. About 6 per cent. (including some of each of the three groups just mentioned) are supposed to occur also in the West Indies, but none are unquestionably native in the Old World.

Notes on the distribution of certain species of particular interest observed on this trip will appear in a subsequent paper.

TALLAHASSEE, FLORIDA.

Local flora notes—V*

NORMAN TAYLOR

AMARYLLIDACEAE

1. *Hypoxis hirsuta* (L.) Coville. Of all the stations in our range,† and there are a good many, none is at a greater elevation than 500 ft. The recent catalogue of Connecticut plants says of it, "Common." If it is found throughout that state it reaches greater altitudes than our collections show. No specimens are known from the Catskills or from the Pocono region.

IRIDACEAE

1. *Iris versicolor* L. There are a good many specimens from the range, only one of which, however, comes from south of Monmouth Co., N. J. This is a single specimen from Forked River, N. J. Is the plant ever found well within the pine-barren region? In the catalogue of New Jersey plants it is said "Common in the eastern and southern counties; less frequent in the northwestern part of the state." We have no specimens from the latter territory but a few along the eastern counties, one only from south of Monmouth Co.

2. *Iris Pseudacorus* L. General works say of this that it is established from Massachusetts to New Jersey. Our only specimen is from near Prince's Garden, at Flushing, L. I., and has all the hall marks of an accidental escape. Such a record cannot be construed into a logical basis of asserting that the plant is "established." A conservative interpretation of this would demand at least a three year's persistence of a reasonably large quantity of the plants. Has any one ever seen this plant growing

*Continued from Torreya **10**: 145-149. 1910.

†The local flora range as prescribed by the Club's Preliminary Catalogue of 1888 is as follows: All of the state of Connecticut; Long Island; in New York the counties bordering the Hudson River up to and including Columbia and Greene, also Sullivan and Delaware counties; all the state of New Jersey; and Pike, Wayne, Monroe, Lackawanna, Luzerne, Northampton, Lehigh, Carbon, Bucks, Berks, Schuylkill, Montgomery, Philadelphia, Delaware, and Chester counties in Pennsylvania.

in our range where there is every reason to suspect that the colony is a permanent feature?

3. *Sisyrinchium angustifolium* Mill. There are only three specimens of this from the range, and they fail to give any adequate idea of the plant's true distribution. All the Pocono region, the upper northwestern part of Connecticut, and the highland section of New Jersey are unrepresented in the collections. With a general range of "Newf. to N. J. and on the mountains to Va.," the plant should be more widely dispersed in our range than the specimens show.

4. *Sisyrinchium albidum* Raf. In the new catalogue of Connecticut plants there is a single specimen cited from New London. An old specimen in our collections, identified by Mr. Bicknell as this species, is from Morrisania, N. Y. City, a locality now completely built over. Otherwise, this western plant is not known from the range.

5. *Sisyrinchium intermedium* Bicknell. In Britton's Manual this plant is credited to southern New Jersey on the authority of E. P. Bicknell, who contributed the treatment of the genus. There are no specimens from the range and the catalogue of the Philadelphia Botanical Club makes no mention of the species.

ORCHIDACEAE*

1. *Cypripedium arietinum* R. Br. The plant is credited to the range in the Preliminary Catalogue of the Torrey Club, but there are no specimens to support this contention. There are rumors of its occurrence in the Orange Mts., N. J., but nothing definitely certain. Its northern distribution is such that the Orange Mts. locality would be a surprising extension of its range.

2. *Cypripedium acaule* Ait. There are over twenty stations for this species represented by specimens. All of these are below 1,000 ft. in altitude, and the plant is unknown, so far, in the Catskills. Can any one contribute specimens that will help to determine the altitudinal range of the species?

3. *Cypripedium Reginae* Walt. (*C. hirsutum* Mill., the name that must be used for our showy lady's slipper orchid). All

*The names used in the discussion of this family are those adopted by Dr. P. A. Rydberg in Britton's Manual. A few exceptions will be found, based on further studies by the same writer.

our specimens come from stations north of Poughkeepsie, N. Y. It is supposed to grow south [in the mountains?] to Georgia. The highland region of New Jersey and Pennsylvania should contain this plant, although no mention of it is made by the Philadelphia botanists, as occurring in the Pennsylvania region.

4. *Cypripedium parviflorum* Salisb. In New Jersey the most southerly point from which the plant is known is Lake Hopatcong. With a general known distribution from Newfoundland to Georgia, etc., the delimitation of this species in our range to the region north of upper New Jersey is probably quite wide of the mark. In New York we have specimens from Van Cortlandt Park, New York City, and Mt. Vernon, neither of which are materially south of the Jersey record.

5. *Cypripedium candidum* Muhl. In all the general works, in Britton's catalogue of New Jersey plants and in the Preliminary Catalogue of the Torrey Club this plant is credited to the range. The only specimen is an old one from "Swamp, Bergen, N. J." Otherwise the plant is unknown in our area.

6. *Cypripedium hirsutum* Mill. The name we must now use for this plant is *C. pubescens* Willd. Its distribution is about as the books indicate but specimens are lacking from all the Pennsylvania counties.

Note.—In Torreya **2**: 84–87, Dr. Rydberg calls attention to still another lady's slipper, a plant little known and inadequately understood. It is one of the yellow-flowered sorts, referable according to that writer to *C. flavescens* Red. Any specimens (particularly flowers preserved in fluid) would be very welcome in clearing up the identity of this species.

7. *Orchis rotundifolia* Pursh. In the Preliminary Catalogue of the Torrey Club this species was credited to the area, but apparently mistakenly so, as there are no specimens from the range. Its northern range almost precludes the idea of its occurrence in our area, the only likely place being the highest peaks of the Catskills.

8. *Gymnadeniopsis integra* (Nutt.) Rydb. Credited to our range in the Manual and definitely to Monmouth, Ocean, and Burlington counties, N. J., in the catalogue of New Jersey plants. There are no specimens and its distribution in the pine-barren is wholly conjectural, beyond that given above.

9. *Gymnadenia conopsea* R. Br. So far as known, this is the first record of the occurrence of this plant in America. It is a native of Europe. Our specimen is from Litchfield, Conn., and is undoubtedly authentic. Whether or not it is established there is unknown, as the collector of it does not remember it particularly. I am indebted to Dr. Rydberg for the determination of this unfamiliar orchid.

10. *Limnorchis huronensis* (Nutt.) Rydb. The only specimens are from Canaan, Conn., and Ulster Co., N. Y. Mt. Pleasant, Wayne Co., Pa., is cited in Porter's Flora of Pennsylvania and this is presumably backed by a specimen. Otherwise the distribution of the plant in our range is unknown.

11. *Limnorchis major* (Lange) Rydb. Only a single specimen from the range is known. This was collected at "North Yonkers," N. Y. (?). The general distribution of this species is from Greenland to New York. The New York part of this assertion is backed by our local flora plant, and in view of the fact that it is supposed to come from Yonkers the distribution is very poorly supported. A high Catskill plant might have been this species but it seems only reasonable that the label reading "North Yonkers" belongs to some other plant, and that if *L. major* is in our range at all, which is very doubtful, it may be in the higher Catskills. The specimen is correctly determined but the label probably belongs elsewhere.

12. *Lysias orbiculata* (Pursh) Rydb. The most southerly station represented in our collections is West Point, N. Y. With a general distribution that extends south [in the mountains] to North Carolina, the plant should be found in the highland region of New Jersey and Pennsylvania. It is fairly common in the Catskills.

13. *Blephariglottis cristata* (Michx.) Raf. Most of the specimens come from near Monmouth County, N. J. Its general distribution is supposed to be from New Jersey to Florida and any information as to the plant's distribution in southern New Jersey will be welcome.

14. *Blephariglottis grandiflora* (Bigel.) Rydb. This species is supposed to grow south [in the mountains?] to North Carolina. All our specimens are from upper New Jersey and the Catskill region. Nothing is known of this from southern New Jersey or from the Pennsylvania counties in our range.

15. *Blephariglottis psychodes* (L.) Rydb. This has the same general range as the preceding, and, so far as the local collections show, is restricted in our area to the same region as that species.

16. *Blephariglottis peramoena* (A. Gray) Rydb. The only specimen is from Chester Co., Pa. It is credited to New Jersey in the Manual but specimens are lacking to show its true distribution in that state. Has it been collected in the Cape May region?

17. *Pogonia divaricata* (L.) R. Br. The only specimen from the range is from Quaker Bridge, N. J. It does not seem credible that a species that is supposed to grow throughout southern Jersey is so localized as our specimens show. How far north in the pine-barren region may the plant be looked for?

18. *Isotria affinis* (Austin) Rydb. This plant is described as rare and local, and is supposed to grow from Connecticut to southern New York, Pennsylvania, and New Jersey. Our only specimen is from Closter, N. J., its type locality. According to the Connecticut botanists it is known only from New Haven and Stratford in that state. From where is it known in Pennsylvania?

19. *Triphora trianthophora* (Sw.) Rydb. With a general distribution from Vermont to Florida, our specimens from Palisades, New Jersey, and Elm Station, near Philadelphia, are grotesquely inadequate, as far as representing the distribution in the area is concerned. Any extension of the range will be welcome.

20. *Arethusa bulbosa* L. The specimens and all the books show that this plant becomes increasingly scarce northwards. The lower counties of Pennsylvania and New Jersey are well represented. All the counties in the former state above Chester, except one station in Wayne, are apparently lacking the plant. North of the New Jersey state line, New York is also not represented by specimens. The Connecticut botanists say that it is rare or local, but not a word as to its state distribution. What is the true distribution of this plant above the line of the coastal plain?

21. *Epipactis viridiflora* (Hoffm.) Reich. The only station for this in the range is the recently discovered one at Plainfield, N. J. This is a marked southerly extension of its range, and it should be expected in the mountains of Pennsylvania and in the Catskills. It is otherwise known from Syracuse and Niagara Falls.

22. *Listera cordata* (L.) R. Br. New Durham, N. J., and Wayne Co., Pa. are the only places within the range from which the plant has been collected, and it is apparently not known to the writers of local floras that bear on our region. The new Connecticut list makes no mention of the plant. The Pennsylvania flora has only the Wayne Co. station. A general range of from Labrador to New Jersey would argue a more extended representation than our limited collections show. It should be found in the Catskills.

23. *Listera australis* Lindl. A single specimen from a swamp southwest of Camden, N. J., is all there is to show for the range of this species. The New Jersey and Philadelphia lists both give another station, at New Brunswick, N. J. Otherwise, the distribution of the plant is unknown save for one station in Chester Co., Pa. The general range of from New York and New Jersey to Florida is scarcely borne out by our scanty material.

24. *Gyrostachys stricta* Rydb. No specimens from the range. General works credit it to our area, but apparently the only specifically recorded station is Norfolk, Conn. It is probably to be found in the adjacent mountains along the eastern edge of Columbia Co., N. Y., and perhaps also in the Catskills.

25. *Gyrostachys plantaginea* (Raf.) Britton. Our only specimen is from Flatbrookville, Sussex Co., N. J. Other recorded stations seem to indicate that so far as our local flora range is concerned the plant is confined to the Delaware River Valley, or its branches. Is this a correct assumption?

26. *Peramium ophioides* (Fernald) Rydb. So far as the specimens show, this plant is confined to the higher Catskills and the mountains of Pennsylvania. So far as known, it has never been reported from New Jersey but might be looked for in the northern hilly part of the state. *P. tesselatum* (Lodd.) Rydb. has a similar range and is restricted in the same way. Can either of the plants be found at an elevation less than 1,000 ft.?

27. *Achroanthes monophylla* (L.) Greene. With the single exception of Sam's Point, Ulster Co., N. Y., for which there is a specimen, the only recorded station for this species is Wayne Co., Pa. It is curious that the plant should not have been found in Delaware and Greene counties, N. Y.

28. *Aplectrum hyemale* (Muhl.) Torrey. The only specimen is from Peekskill, N. Y. The early numbers of the Bulletin of the Torrey Botanical Club credit it to Pine Plains, N. Y., and Closter, N. J., and other stations are recorded in northern New Jersey. From New Brunswick, N. J., southwards the plant is unknown, save a record in the Philadelphia catalogue from Swedesboro, Gloucester Co. The general distribution of "Ontario to Georgia" is too general to represent adequately the restricted range of this plant.

29. *Corallorhiza Corallorhiza* (L.) Karst. The only specimen is from the summit of Onteora Mt., Greene Co., N. Y. Where in the mountains of Pennsylvania, except Wayne Co. from which it is reported, may the plant be looked for?

30. *Corallorhiza Wisteriana* Conrad. With a general range from Massachusetts to Florida, the only recorded stations are from Chester and Philadelphia Co., Pa. There are no specimens. Is this delimitation correct?

NEW YORK BOTANICAL GARDEN.

Notes on Rutaceae — IV

Percy Wilson

In the large collection of plants recently made in eastern Cuba by Dr. J. A. Shafer there are two species of Rutaceae which hitherto have apparently escaped recognition. Descriptions of them follow:

Ravenia Shaferi P. Wilson, sp. nov.

A glabrous shrub or tree, 4–7 m. tall, with a grayish bark. Leaves simple, elliptic to ovate, or occasionally somewhat obovate, 5–10 cm. long, 2–5 cm. broad, sessile or subsessile, entire, more or less revolute, acute or occasionally obtuse at the apex, acute or somewhat rounded at the base, glandular-punctate; inflorescence 2–7-flowered; sepals 4, very unequal, the two outer ovate to broadly ovate, 1–1.8 cm. long, 0.6–1.2 cm. broad, the two inner ovate to nearly oval, 5–7 mm. long, 4.5–5.5 mm. broad, all glandular-punctate; "corolla red," glandular-punctate, the tube cylindric, 1.2–1.5 cm. long, the lobes 4, unequal, oblong to oblong-obovate, 1.4–2 cm. long, 0.8–1 cm. broad; stamens 4, adnate to the throat of the corolla, the two inferior ones fertile, sessile, the two superior ones sterile, linear to subulate, flattened; disk cup-shaped; ovary 4-lobed, 4-celled, immersed in the disk; style filiform; stigma 4-lobed.

Type collected in alluvial valley of Rio Yamaniguey, Province of Oriente, Cuba, *Shafer 4218*.

Distribution: Eastern Cuba.

The other species of *Ravenia*, so far as I know, are 5-merous.

Spathelia cubensis P. Wilson, sp. nov.

A slender, branchless tree, 1–3 m. tall; new growth and under surface of the young foliage velvety with a reddish stellate pubescence intermixed with simple hairs. Leaves odd-pinnate, 3–3.5 dm. long, the rachis wingless, narrowly grooved above, velvety when young, glabrous or nearly so with age; leaflets 41–57, those on the branches of the inflorescence fewer in number, oblong, 3–7 cm. long, 6–10 mm. broad, sessile, entire, more or less revolute, acutish or rounded at the gland-tipped apex, cordate or sometimes inequilateral at the base, dull gieen above and glabrous, paler be-

neath and more or less stellate-pubescent; inflorescence paniculate, the branches glabrous or nearly so; flowers scarlet; sepals elliptic, 3–3.5 mm. long, 2 mm. broad, gland-tipped, acutish; petals elliptic-oblong or oblong, 5–6 mm. long, 2–3 mm. broad, gland-tipped, acutish, filaments with wing-like appendages at the base, anthers oblong; ovary glabrous, three-angled.

Type collected in dry rocky places, Sierra Nipe, along trail from Piedra Gorda to Woodfred, Province of Oriente, Cuba, *Shafer 3091;* collected also by Wright (*2192*) at Mayari.

DISTRIBUTION: Eastern Cuba.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1910)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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BULLETIN

OF THE

TORREY BOTANICAL CLUB

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Studies on the Rocky Mountain flora—XXIII

PER AXEL RYDBERG

Gaillardia Mearnsii sp. nov.

Annual; stem 1–3 dm. high, leafy only towards the base, finely pubescent; basal leaves oblanceolate or spatulate, petioled, 5–10 cm. long, puberulent, entire or round-lobed; upper leaves similar or sometimes pinnatifid with rounded lobes; peduncles 1–2 dm. high; involucres about 2 cm. broad; bracts lanceolate, acute, grayish-pubescent; disk-corollas purple, their lobes short and rounded, fimbriate; pappus-scales lanceolate, each gradually attenuate into a slender awn equaling the corolla; rays yellow, 10–15 mm. long.

The type sheets were labeled *G. aristata*, which it somewhat resembles in general habit, but the lobes of the disk-corollas are not attenuate. It resembles, however, still more, *G. arizonica* in the annual root, the stem naked above, and the leaf-form, although the leaves are more inclined to be entire; but it differs from that species in the purple disk and the gradually acuminate and long-aristate pappus-scales. On the whole, it is therefore more nearly related to *G. pinnatifida*, although the plant is evidently an annual and the leaves are seldom pinnatifid. When pinnatifid, their lobes are short and rounded.

ARIZONA: Fort Verde, May 4, 1888, *Mearns 322* (type, in herb. N. Y. Bot. Gard.).

UTAH: Sandy bluffs near Green River, June 12, 1900, *Stokes*.

TETRANEURIS

In Coulter & Nelson's New Manual the name *Actinella* Nutt. has been readopted for this genus, apparently in conformity with

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the Vienna Rules. Nuttall, however, did not intend to propose a new genus *Actinella*, but thought that the *Galardia acaulis* of Pursh belonged to *Actinella* Pers., based on *Actinea* Juss. In reality there is no such thing as *Actinella* Nutt. *Actinella* Pers. is a synonym of *Cephalophora*, to which even DeCandolle thought *Galardia acaulis* belonged.

The way Professor Nelson has handled other persons' species of this genus and his own is very arbitrary. *Actinella simplex* A. Nels., *A. incana* A. Nels., and *A. eradicata* A. Nels. he keeps distinct from *A. acaulis* (Pursh) Nutt. Both *Actinella depressa* A. Gray and *Tetraneuris brevifolia* Greene he makes synonyms of his own *Actinella acaulis caespitosa*, and *Tetraneuris glabra* Greene and *T. glabriuscula* Rydb. of his own *Actinella epunctata*. He unites *T. linearis* Greene (Nutt.) and *T. angustifolia* Rydb.; *T. fastigiata* Greene and *T. stenophylla* Rydb.; and lumps under *Actinella leptoclada* A. Gray not only *Tetraneuris mancosensis* A. Nels. and *T. intermedia* Greene but also *T. Crandallii* Rydb., *T. arizonica* Greene, and *T. pilosa* Greene (?).

My studies of the genus have given me quite different results. *Galardia acaulis* Pursh was collected by Bradbury in "Upper Louisiana." Any one who knows a little about Bradbury's travels knows that this meant along the Missouri River, somewhere between St. Louis, Mo., and Fort Mandan, N. D. Further, the type locality must have been in South Dakota or North Dakota, as no species of *Tetraneuris* is known to grow near the Missouri south thereof. The common plant of the plains and hills of the western part of the Dakotas and Nebraska has densely silky, linear-oblanceolate leaves. It is well represented by my own *nos. 106* and *196*, by *MacDougal 53* from Nebraska, and by *Bolley 404* from Mendora, N. D. It is true that the type of *Tetraneuris incana* A. Nels. (*Elias Nelson 5006*) is slightly more delicate and whiter than these, but *A. Nelson 8265*, determined by the author himself as *T. incana* matches perfectly my *no. 106*. *Actinella* or *Tetraneuris incana* A. Nels. is therefore in my opinion the true *T. acaulis* (Pursh) Greene. It is the only one that has been collected in the neighborhood of the type locality. The only other species that has been collected in the Dakotas or Nebraska is *T. simplex* A. Nels. and that only in the very extreme western

portion. The latter does not agree with the description of *Galardia acaulis.*

I have come to the conclusion also that *Tetraneuris eradiata* A. Nels. is but a rayless form of *T. acaulis.* My *no. 106* contains both radiate and rayless specimens. The disk-flowers of *T. eradiata* are said to be "almost orange." They usually turn more or less orange in age in *T. acaulis* and the type of *T. eradiata* is pretty well advanced in age. There are no other distinctive characters either in the description or in the specimens that I can see.

Even *Tetraneuris simplex* is not too good a species and it is very close to *T. acaulis* on one hand and *T. trinervata* Greene on the other. The latter I had reported for Colorado in my Flora of Colorado; but it is wholly ignored by Nelson. As the New Manual includes northern New Mexico, the type locality even of *T. trinervata*, viz., Sandia Mountains, N. M., between Santa Fé and Albuquerque, is within the range.

What Professor Nelson's interpretation of *Actinella acaulis* really is, is hard to tell, for some of the specimens he has distributed under that name and *Tetraneuris acaulis* belong to *T. lanata* and others to *T. acaulis caespitosa* A. Nels. Most of them were distributed before the latter was segregated. Both *E. Nelson 4329*, distributed as *T. acaulis*, and *A. Nelson 4607*, distributed as *T. lanata ?*, match perfectly a part of the type of Nuttall's *Actinella lanata* in the Torrey herbarium. All three are very young.

It is evident that *Actinella acaulis caespitosa* A. Nels. is more closely related to *A. lanata* than to *A. acaulis.* It has the loose pubescence of *A. lanata*, a character best seen in age. I am inclined to think that it is the same as *Tetraneuris brevifolia* Greene, although I have not seen the type of the latter. It should then bear that name, unless it is reduced to a variety of *A. lanata.* The plant was first collected by James in Long's Expedition on James Peak (now Pikes Peak), the type locality of *T. brevifolia.* Torrey* referred this specimen to *Actinea integrifolia* Kunth; but in Torrey and Gray's Flora,† it was referred to *Actinella lanata* with the following remark: "The specimen of

*Ann. Lyc. N. Y. 2: 213.

†2: 382.

A. integrifolia? Torr. *loc. cit.* is so imperfect that we can not very confidently refer it to the present species; but it certainly is not the same with the foregoing" [*A. Torreyana*].

When preparing the manuscript of the Flora of Colorado, I overlooked the publication of *Tetraneuris epunctata* A. Nels. Otherwise I should not have proposed *T. glabriuscula* to replace the untenable *T. glabra* Greene. I am perfectly willing to reduce the last two to synonymy. This is, however, not the case with *T. angustifolia.* In the key Professor Nelson has a division, "Crowns of the caudex short" in contrast to "Crowns of the caudex fastigiate and elongated, 1–2 dm. high." Under the first division he includes *Actinella linearis.* If he had given *A. angustifolia* instead it would have been correct. The type of *Actinella scaposa linearis* was collected by Riddell in Texas and is preserved in the Torrey herbarium. It has elongated branches of the caudex as have *Tetraneuris fastigiata* and *T. stenophylla*, and differs from them mainly in the fact that the bases of the leaves are scarcely dilated. I think that *Tetraneuris fastigiata* and *T. stenophylla* also are distinct. This is only a matter of difference in opinion as to limitation of species. If they are to be united, they should be included in *T. linearis*, which is just as closely related. *Tetraneuris angustifolia* on the contrary is more distinct and related to *T. Torreyana*, but lacks the hair-tufts at the bases of the leaves.

Tetraneuris mancosensis A. Nels. is a synonym of *Actinella leptoclada* A. Gray. I am now inclined to regard *T. intermedia* Greene also as such, although I kept it distinct in the Flora of Colorado. But I think it goes too far in "lumping," if one tries to include the acaulescent *Tetraneuris Crandallii*, *T. arizonica*, and *T. pilosa* in the leafy-stemmed *T. leptoclada*. Besides the difference in habit the acaulescent species have abruptly aristate pappus-scales, while in *T. leptoclada* the scales taper gradually into the bristle-point. *Tetraneuris Crandallii* in habit closely resembles *T. Torreyana*, but the scape in not villous and the pappus is different. *T. arizonica*, in which I am inclined to include *T. pilosa*, resembles *T. epunctata*, but the leaves are more hairy, more punctate, and have conspicuous hair-tufts at the bases.

It seems as if enough species have been proposed in this genus,

but still there is a plant of Montana, Idaho, and Saskatchewan, related to *Tetraneuris acaulis*, though differing in so many respects that it would be inconsistent to include it in that species. I therefore propose it as new:

Tetraneuris septentrionalis sp. nov.

An acaulescent perennial, with a short, thick cespitose-pulvinate caudex; leaves spatulate or oblanceolate, mostly rounded at the apex, 1.5–4 cm. long, 5–8 mm. wide, canescent-tomentose, subvelutinous; scape 5–10 dm. high, rather thick, appressed-tomentose; involucres 6–7 mm. high, 12–15 mm. broad, densely villous; bracts elliptic, rounded at the apex; rays 8–10 mm. long, 5–6 mm. wide, very strongly veined; achenes silky-strigose; pappus scales ovate, abruptly short-aristate.

This is related to *Tetraneuris acaulis* and *T. simplex*, but differs from both in the broader leaves, the looser pubescence, the usually shorter and stouter scape, and short bristle-tips of the pappus scales; from the former of these also in the less silky pubescence and the larger and more strongly veined rays, and from the latter in the dense pubescence.

IDAHO: Palouse Country, June–July, 1892, *G. B. Aiton* (type, in herb. N. Y. Bot. Gard.).

MONTANA: Fort Benton, *John Persall 926*; Livingston, June, 1899, *Tweedy*.

SASKATCHEWAN: Cypress Hills, June 23, 1894, *John Macoun 5078*.

WYOMING: Yellowstone Park, June, 1888, *C. H. Hall*.

Hymenoxys Macounii (Cockerell) Rydb. comb. nov.

Hymenoxys Richardsoni, var. *Macounii* Cockerell, Bull. Torrey Club **31**: 474. 1904.

It is not plain whether Professor Cockerell intended this as a variety of *H. Richardsoni* or of his *H. Richardsoni*, subsp. *pumila*. From the discussion, the latter interpretation seems most probable, but technically it seems to have been made a variety of the species. In habit it is most like *H. pumila*, but it has one character that was overlooked by Professor Cockerell, viz., the outer bracts are much thickened on the back, even subcarinate. This would associate the plant with *H. floribunda*

rather than with *H. Richardsoni.* The rays are, however, not so broad or so decidedly cuneate as in that species. The following specimens belong to *H. Macouni.*

SASKATCHEWAN: 1858, *Bourgeau;* Cypress Hills, 1880, *John Macoun*; Medicine Hat, 1894, *John Macoun 5077*; Bare Hills, 1906, *Macoun & Herriot 72840.*

MONTANA: "Northwest Boundary," 1874, *Coues;* Falls of Missouri, 1886, *R. S. Williams 4520;* Midvale, 1903, *Umbach 150;* Manhattan, 1895, *Rydberg 2936.*

Hymenoxys Greenei (Cockerell) Rydb. comb. nov.

Picradenia biennis Greene, Pittonia 3: 272, in part. 1898. Not *Actinella biennis* A. Gray. 1878.

Hymenoxys Lemmoni Greenei Cockerell, Bull. Torrey Club **31**: 479. 1904.

I think this is specifically distinct from *Hymenoxys Lemmoni.* The best character to distinguish the two was not pointed out by Professor Cockerell or by Dr. Greene. The inner bracts in *Palmer 261*, the type number of *H. Greenei*, of which there are five specimens on two sheets in the Columbia University herbarium, are broadly obovate and more or less erose-dentate on the margins, while in all specimens seen of *H. Lemmoni* they are elliptic and entire. *Watson 616*, from Nevada and referred to the subpecies *Greenei*, belongs to *H. Lemmoni.*

DUGALDEA

Professor Nelson included in this genus *Hymenoxys helenioides* Cockerell (*Picradenia helenioides* Rydb.), on what ground I do not know. Both I, who, with Mr. Vreeland, discovered the plant, studied it in the field, and described it, and Professor Cockerell, who has spent so much time on *Hymenoxys*, believed it a good species of that genus. In *Dugaldia Hoopesii* the bracts are in more than two series,. distinct, and in age reflexed; in *Hymenoxys helenioides* they are as in the rest of that genus not reflexed, in strictly two series, and those of the outer series are united at the base.

DYSODIA

Nelson in the New Manual has evidently given *Dysodia* Cav. the same limitation as it has in Engler & Prantl's Pflanzen-

familien, *i. e.*, including *Adenophyllum*, *Hymenatherum*, *Aciphyllaea*, *Thymophylla*, and *Lowellia*. If so, the name *Dysodia papposa* (Vent.) Hitch. and *D. aurea* (A. Gray) A. Nels. can be used; but if these genera are to be regarded as distinct or if they are limited as by Gray and by Hemsley, the names are not the correct ones. The monotype of *Dyssodia* Cav. (originally spelled with two *s*'s), is *D. Porophyllum* = *Adenophyllum* Hemsl., which is not congeneric with either of these species according to Hemsley. The only available generic names for the two species of the Rocky Mountain region would be *Boebera* Willd. and *Lowellia* A. Gray, respectively.

ARTEMISIA

The treatment of *Artemisia* in the New Manual of the Central Rocky Mountains is very unsatisfactory. The author has kept up five of his own species and reduced every species proposed by any one else since 1884 and some before that year, either to synonymy or else to a variety of some older species, except *Artemisia saxicola* Rydb., which was a substitute for the North American so-called *A. norvegica*. Now let us see what the facts really are. There are only two species of Professor Nelson's that I am inclined to uphold, viz., *Artemisia aromatica* and *A. nova*. In such a "conservative" work as the New Manual generally is, even these ought to have been reduced to varieties.

It is questionable if *Artemisia aromatica* A. Nels. can be kept specifically distinct from *A. dracunculoides*. The latter is fully as common in the Rockies as is *A. aromatica*, and even one specimen distributed from the University of Wyoming and named *A. aromatica*, viz., *Goodding 602*, is typical *A. dracunculoides*. Also an older specimen, *Nelson 2469*, belongs here.

Artemisia nova A. Nels. was not altogether new when it was described. In fact, several specimens were found in herbaria before that time under the name *Artemisia arbuscula*. If I am not mistaken, it constituted a part of Nuttall's original *A. arbuscula*, although the description fits better the other part, which therefore may be regarded as the type. Dr. Gray* states: "Two forms, passing into each other (both collected by Nuttall, * * *); one with involucres more campanulate, 7–9-flowered; in the other oblong and only 4–5-flowered." The latter is *A. nova* A. Nels.

*Syn. Fl. 1[2]: 374.

The other Nelsonian species have in my opinion no claim to specific rank. Two duplicates of the type of *Artemisia gracilenta* A. Nels., one in the Columbia University herbarium and the other in the New York Botanical Garden collection, are almost identical with the two original specimens of *A. floccosa* Rydb. The only difference is that the segments of the leaves of the former are somewhat narrower. There are also two duplicates of *A. paucicephala* A. Nels., which differs from *A. floccosa* only in the fact that the upper leaves are entire. As Nelson himself unites *A. paucicephala* and *A. gracilenta* and the original *A. floccosa* is intermediate between the two, I see no reason why they should not be reduced to synonyms of *A. floccosa*, which is three years older.

Artemisia subglabra A. Nels., of which there are two duplicates here, is identical with *A. graveolens* Rydberg, three years older. The leaves of even Nelson's own specimens show traces of tomentum on the lower surface. The species is related to *A. discolor*, not to *A. saxicola*, with which Nelson has placed it.

Artemisia natronensis A. Nels. is, according to a duplicate of the type and several specimens distributed from the University of Wyoming, the same as *A. longifolia* Nutt., as that species is understood. The specimens which I referred to *A. natronensis* in my Flora of Colorado do not belong there. They are unusually large-headed *A. diversifolia* or at least closely related to it. I wish to make this correction here.

Now let us take up the species reduced by Professor Nelson. *Artemisia Scouleriana* (Besser) Rydb. and *A. Forwoodii* S. Wats. are reduced to synonyms of *A. canadensis*.

Artemisia canadensis Michx. is a subarctic plant and not found in the Rocky Mountains within the United States. The type came from the shores of the Hudson Bay. It is a low plant with the leaves mostly basal, with narrowly linear divisions, and comparatively few heads nearly as large as those of *A. spithamaea* Pursh (*A. borealis* Auct. Am.) and in a narrow panicle. I have seen specimens from the White Mountains; Vermont; the Gaspé Peninsula, Que.; Keweenaw Point, Mich.; and the Yukon Territory; but from nowhere in our western states. The specimens named *Artemisia canadensis* from there belong to *A. Forwoodii* or *A. Scouleriana*. Whether the latter two should be regarded as

distinct is questionable, but they are evidently different from *A. canadensis*, and Besser, regarding them as such, referred them, first to *A. desertorum* and later to *A. commutata*. In the original publication,* Dr. Watson compares *A. Forwoodii* with *A. discolor*, to which it has no close relationship. It is the same as *A. desertorum Hopkeriana* Besser.†

Artemisia kansana Britton and *A. stenoloba* Rydb. are given as synonyms of *A. Wrightii*. The description of the last in the New Manual is mostly copied from Dr. Gray, who perhaps included *A. kansana*, but the type, *Wright 1279*, is not the same as *A. kansana* Britton. The plant Professor Nelson had in mind is evidently *A. kansana* and not the true *A. Wrightii*, judging from the key and from the association with *A. coloradensis* Osterhout. The true *Artemisia Wrightii* has an involucre only slightly tomentose and the leaves glabrate above and is very close to *A. Bakeri* Greene, differing mainly in the erect instead of nodding heads. If *Artemisia Bakeri* should be reduced to a variety of *A. mexicana*, *A. Wrightii* should also. *A. stenoloba* Rydberg was never described, but the specimens so named in manuscript belong to *kansana*. There is however, an older name for this species, viz., *A. Carruthii* Wood, as pointed out by Mr. Mackenzie.

Artemisia rhizomata A. Nels., *A. pudica* Rydb., *A. pabularis* (A. Nels.) Rydb., *A. Purshiana* Besser, and "probably" *A. candicans* and *A. floccosa* Rydb. are reduced to synonyms of *A. gnaphalodes* Nutt. If *A. rhizomata* and *A. pabularis* (originally described as a variety by Nelson) are reduced to synonymy I shall enter no protest. I do not know what the first really is. One specimen in the Columbia herbarium bears the type number, but it does not agree with the original description and the label evidently has been interchanged. Some of the specimens distributed later under that name belong to the form of *A. gnaphalodes* common in the Rocky Mountain region. The form growing in Wisconsin, the type state of *A. gnaphalodes*, looks quite different, although it is almost impossible to characterize the differences in words. *Artemisia pabularis* is a peculiar plant, in some respects intermediate between *A. gnaphalodes* and *A. microcephala* Wooton,

*Proc. Am. Acad. 25: 133. 1890.

†Hook. Fl. Bor.-Am. 1: 325. 1833.

but with narrower leaves than either. *A. pudica* Rydb. is related to *A. gnaphalodes* and *A. diversifolia*, but in my opinion distinct. This is, of course, a matter of individual opinion. *A. Purshiana* is a northern plant with much broader leaves and denser inflorescence than the ordinary *A. gnaphalodes*. It is common in British America and Montana, has been collected in the Dakotas, and one specimen from Nevada I have referred doubtfully here, but I have seen no specimens from Wyoming or southward. Perhaps this species is unknown to Professor Nelson.

I must protest, however, against the reduction of *Artemisia candicans* Rydb., and *A. floccosa* Rydb. to synonyms of *A. gnaphalodes*. *Artemisia floccosa*, as stated above, should take the place of *A. paucicephala* and *A. gracilenta*, and the *A. candicans* is related to it. Using Nelson's key, one would place it in *A. paucicephala*, but the heads are still broader, sessile in small clusters, nodding or spreading, instead of erect, and the tomentum is more loose.

Artemisia Underwoodii Rydb., *A. Brittonii* Rydb. and *A. latiloba* (Nutt.) Rydb. are made synonyms of *A. ludoviciana* Nutt. I doubt if Professor Nelson knew what the first two are. One specimen of *A. Underwoodii*, viz., *Goodding 1934*, was distributed from the University of Wyoming under the name *A. silvicola* G.E.O. Both *A. Underwoodii* and *A. silvicola* are perhaps more closely related to *A. mexicana* than to *A. ludoviciana*.

Artemisia Brittonii Rydb. has the leaves permanently tomentose on both sides and would be placed in *A. gnaphalodes* if Nelson's key were used. It is most nearly related to *A. Purshiana*, but has at least the lower leaves deeply lobed.

Artemisia latiloba (Nutt.) Rydb. should be known as *A. Hookeriana* Besser. I have seen a duplicate of the latter in the Gray herbarium and there is no doubt that it is the same as my *A. latiloba*. It is a northern plant, not found in Wyoming and rare in Montana. It has the same leaf-form as *A. elatior* and *A. Suksdorfii*, but the inflorescence is denser and the involucre is densely tomentose. It is sometimes hard to distinguish from, and in the west seem to grade into, what has been known in California and Nevada as *A. heterophylla* Nutt. The latter name is

untenable and belongs evidently to *A. Suksdorfii.* The California-Nevada plant has been described as *A. Kennedyi* A. Nels., but even this must pass into synonymy, for the plant has an older name, *A. Douglasiana* Besser.

Under *Artemisia discolor* is given as a synonym: "*A. elatior* (T. & G.) Rydb. as to our range." *A. discolor* and *A. elatior* can never be confused, but perhaps this could happen with the latter and *A. incompta* Nutt., which Nelson has regarded as a variety of *A. discolor,* following Dr. Gray. Good specimens of *A. elatior,* resembling the type in the Columbia University herbarium, have been collected in Montana and one specimen which I can refer to no other described species we have from Colorado.

Artemisia spiciformis Osterhout is reduced to a synonym of *A. arbuscula* Nutt. It is not related to that species but is related to *A. Rothrockii* A. Gray. The specimens from Utah collected by Ward and Parry and referred to by Dr. Gray,* belong to *A. spiciformis* Osterhout.

Nelson has also reduced several species to varieties, viz., *A. Parryi* A. Gray, *A. coloradensis* Osterhout, *A. diversifolia* Rydb., *A. silvicola* Osterhout, and *A. Bakeri* Greene.

There is scarcely any better species than *A. Parryi* and it can never be justly referred to *A. saxicola.* Not only has the plant "a tendency to become glabrate," but the pubescence, if any is present, is not that of *A. saxicola,* but is short-silky and appressed, the heads are usually much more numerous than in that species and not racemose, and the corollas are perfectly glabrous. If it were not for the absolute lack of tomentum I should place it next to *A. franserioides* and *A. discolor.* It is strange that Professor Nelson reduced this species to a variety, while he regarded *A. Pattersonii* as distinct from *A. scopulorum.* Besides, what rules of nomenclature was he following, when he reduced the older species *A. Parryi* to a variety of the later *A. saxicola?*

Artemisia coloradensis Osterhout is made a variety of *A. Wrightii.* As *A. Wrightii* of Nelson is not the original *A. Wrightii* A. Gray, but *A. kansana* Britton (see above), a new combination is necessitated, if the specific rank of *A. coloradensis* is not upheld.

Artemisia diversifolia Rydb. is made a variety of *A. gnapha-*

*See Syn. Fl. 1^2: 375.

lodes Nutt. This is of course a matter of individual opinion. It is fully as good as the two Nelsonian species *A. aromatica* and *A. nova*, which I am inclined to admit.

Artemisia silvicola Osterhout and *A. Bakeri* Greene are made varieties of *A. mexicana*. The former is, as stated before, related to *A. mexicana*, but the latter is very hard to distinguish from the original *A. Wrightii*. *A. mexicana* is not found in the Rockies and not even near them. What goes under that name from New Mexico and Arizona is mostly either *A. neo-mexicana* Greene or *A. microcephala* Wooton. The latter extends into southern Utah and Nevada.

So many species have already been proposed in this genus that it may seem a little hazardous and unnecessary to add more to the already too large number. There are, however, two plants, both collected by *Bourgeau* on the Palliser Expedition in Saskatchewan, that can not be included in the species known by me, so that it seems better to give descriptions of them here. The second one was rediscovered in Alberta by Macoun and Herriot.

Artemisia Bourgeauana sp. nov.

Perennial with a tap-root and short caudex; stem silky-pubescent, more or less tinged with red, 3–4 dm. high; basal leaves petioled, 4–6 cm. long, sericeous-canescent on both sides, twice-pinnatifid with oblanceolate divisions; stem-leaves pinnatifid with linear, crowded divisions, rather small; heads numerous in a narrow panicle; involucres nearly 5 mm. wide, silky-villous, yellowish and shining; bracts oval, broadly scarious-margined; flowers light yellow, the central ones sterile.

This species is perhaps most closely related to *Artemisia Forwoodii*, having the same habit and leaf form, but the plant is more silky and the heads are twice as broad, fully as large as in *A. spithamaea* and *A. canadensis*. From the former it differs in the numerous heads, compound inflorescence, yellow instead of brown flowers, and taller stem. From *A. canadensis* it differs in the compact inflorescence, the densely silky leaves, and broader leaf-segments.

SASKATCHEWAN: 1857–9, *Bourgeau* (type, in herb. Columbia University).

Artemisia Herriotii sp. nov.

Perennial with a rootstock; stem 6–10 dm. high or more, tomentose; leaves entire or sparingly and sharply toothed, 5–20 cm. long, 5–15 mm. wide, glabrate and green above, densely white-tomentose beneath, rather thin, margins not revolute; inflorescence a narrow compact panicle with very numerous small heads; branches erect, racemiform; heads erect; involucres about 5 mm. high, 2.5–3 mm. broad; bracts oblong-ovate to ovate, acute or obtuse, yellowish, densely tomentose; flowers yellow, the central ones fertile; receptacle naked.

Bourgeau's specimens were referred to *Artemisia longifolia* by Dr. Gray, but they are not closely related to that species. The leaves are not revolute-margined and the heads are not half the size of those of that species. It is most closely related to *A. silvicola* and *A. Hookeriana* Besser (*A. latiloba* Rydb.). It differs from the former in the denser and narrower inflorescence, the erect heads, the denser tomentum on the involucres, and the firmer leaves, and from the latter in the more entire leaves and the smaller, more cylindric heads.

ALBERTA: Edmonton, Aug. 25, 1906, *Macoun & Herriot 72825* (type, in herb. N. Y. Bot. Gard.).

SASKATCHEWAN: 1858, *Bourgeau* (in herb. Gray).

ACHILLEA

A great diversity of opinion exists among botanists as to the number of species of this genus found in America. Dr. Gray admitted three species, *Achillea Millefolium*, *A. multiflora*, and *A. Ptarmica*. Evidently Nelson held the same view, as he admits only *A. Millefolium*, the other two not being found in the Rocky Mountain region. Piper in his Flora of Washington* admitted *A. lanulosa* Nutt. as variety of *A. Millefolium*. Robinson and Fernald† regarded *A. lanulosa* as a good species. Pollard‡ admitted 10 species as North American. Of these one is Mexican and three escaped or introduced. Afterwards he, in coöperation with Cockerell,§ described an additional species from New Mexico. With the exception of *A. multiflora* and perhaps *A. laxiflora*,

*Contr. U. S. Nat. Herb. vol. 11.

†Gray's New Manual 845.

‡Bull. Torrey Club **26**: 365–375. 1899.

§Proc. Biol. Soc. Wash. **15**: 179. 1902.

which is unknown to me, all the North American species are closely related to *A. Millefolium* and may be only forms of that species. Notwithstanding the fact that *Achillea borealis*, on account of its large heads and numerous rays, has been placed in the *Ptarmica* section of the genus, it is closely related to *A. Millefolium*, and can be connected with it through two different lines of relationship. (See below.) It is very hard to say whether the native species of the *Millefolium* group admitted by Pollard should be regarded as species or as varieties of *A. Millefolium* and my intention here is not to express any opinion on that subject. I only wish to clear certain points regarding which there seems to be a great deal of confusion. I shall here use the specific names that have been applied to the different forms, whenever such are available.

ACHILLEA MILLEFOLIUM L. Sp. Pl. 899. 1753

This is a native of northern Europe and I think also of northern New York and New England and eastern Canada; at least it has naturalized itself in that part of North America. Elsewhere it is only sparingly introduced. It is a characteristic northern plant. It differs from all the other native forms in being less villous and having shorter hairs. The rachis of the leaves is distinctly wing-margined and the primary segments more or less decurrent; they are usually decidedly spreading. The secondary segments are short, lanceolate, and spinulose-tipped. The rays are comparatively large, 2–3.5 mm. broad. The bracts have usually brown margins. In the far north, the plant often becomes more hairy and the margins almost black, and it approaches *A. borealis* on one hand and *A. lanulosa* on the other. Of such specimens we have one from North Iceland, collected by Olasur Davidson, and two collected by Collins and Fernald, one at Carleton Point, Que., in 1904 (labeled *A. lanulosa*) and the other at Mt. Albert, Que., in 1906, *no. 257* (labeled *A. borealis*).

Achillea occidentalis Raf.; DC. Prod. **6**: 24. 1837, as a synonym under

A. Millefolium occidentalis DC. *loc. cit.*

A. Millefolium Pollard, Bull. Torrey Club **26**: 371, in part. 1899. Not *A. Millefolium* L. 1753.

This is evidently the plant that Pollard took for the real

Achillea Millefolium. It is characterized by the small rays, only 1.5–2.5 mm. broad, and straw-colored bracts, pointed out by Pollard. It differs also from *A. Millefolium* in the narrow linear and usually more elongated segments of the leaves. There is also only a trace of a wing-margin on the rachis and the stem is usually more hairy and with longer hairs. DeCandolle regarded it as a variety of *A. Millefolium* and stated that it is intermediate between that species and *A. setacea*, a native of Southern Europe. In my opinion it is nearer to *A. setacea*, having the small rays and narrow segments of that species, but is more hairy. It is the common native form of the prairie region from Wisconsin to Kentucky, Arkansas, and eastern Nebraska, but specimens have been collected as far east as Pennsylvania and South Carolina. Three specimens from southern Colorado I have also referred here.

ACHILLEA LANULOSA Nutt. Journ. Acad. Nat. Sci. Philadelphia **7**: 36. 1834

A. tomentosa Pursh, Fl. Am. Sept. 561. 1814. Not *A. tomentosa* L. 1753.

This resembles the foregoing in many respects; the pubescence (although often more copious) and the color of the bracts are the same. The segments of the leaves are much shorter and more crowded and more directed forward; the rachis has not even a trace of a wing margin and the rays are much larger, 2.5–4 mm. (Pollard gives them up to 6 mm.) broad. This is the common plant of the Rocky Mountain region and its range extends from Saskatchewan to Kansas, New Mexico, northern Mexico, the mountains of California, and British Columbia.

ACHILLEA SUBALPINA Greene, Leaflets **1**: 145. 1905

A. lanulosa alpicola Rydb. Mem. N. Y. Bot. Gard. **1**: 426. 1900.

A. alpicola Rydb. Bull. Torrey Club **33**: 157. 1906.

This resembles a depauperate *Achillea lanulosa* in habit, but the margins of the bracts are strongly colored, usually almost black, though sometimes only brown, and such specimens approach closely *A. lanulosa*. The inner bracts as are a rule decidedly acute and in this respect it resembles *A. borealis*. It differs, however, from that species in the small heads, not over 4

mm. broad, the less numerous rays, and the short and crowded leaf-segments. It belongs to the higher Rocky Mountains.

ACHILLEA BOREALIS Bong. Veget. Sitcha 149. 1832

In many respects this is close to the typical *Achillea Millefolium*. The heads are usually larger and have more rays; the bracts are usually darker but not always so. The main differences are in the inner bracts, which are decidedly acute, the narrow and usually long segments of the leaves, the rachis, which is almost without a wing margin, and the longer pubescence. The leaves resemble much those of *A. occidentalis* and *A. californica*. The range of *A. borealis* extends from the Mackenzie to Alberta, British Columbia, and Alaska. The plant of Newfoundland and Labrador, which has been referred to this species is somewhat different. So far as I know, it has not received any specific name, but it has been described under the following name:

ACHILLEA MILLEFOLIUM NIGRESCENS E. Meyer, Pl. Labrad. 65. 1830

It has the large heads and dark-margined bracts of *A. borealis*, but the bracts are not acute, the leaf-segments are broad and short, and the rachis has a decided wing-margin. It agrees therefore in every respect with *A. Millefolium*, except the larger head and the more numerous flowers.

ACHILLEA CALIFORNICA Pollard, Bull. Torrey Club **26**: 369. 1899

This, so far as I know, is not found in the Rocky Mountain region. It is restricted to the Pacific Coast. It is usually taller and more robust than any of the species mentioned above. The character of the head is practically the same as in *A. Millefolium*, but the heads are larger, about as large as in *A. borealis*. The margins of the bracts are usually not so dark as in that species and none of the bracts are acute. The leaf-form is more that of *A. borealis* and *A. occidentalis*, but the segments are usually still more elongated and more divaricate. The leaves are usually thrice rather than twice pinnatifid.

ACHILLEA ARENICOLA Heller, Muhlenbergia 1: 61. 1904

This resembles in many respects the preceding but is much more copiously villous than any of the other species. The inflorescence is compact and of many large heads. The leaf-segments are short and crowded as in *A. lanulosa*, but the plant is stouter, the heads much larger and the margins darker. It has been mistaken for *A. borealis*, but has neither the blackish margins nor the acute inner bracts of that species.

ACHILLEA GIGANTEA Pollard, Bull. Torrey Club **26**: 370. 1899, and

ACHILLEA LAXIFLORA Pollard & Cockerell, Proc. Biol. Soc. Wash. 15: 179. 1902, are both unknown to me.

The species or forms discussed above are fairly distinct when typical specimens from the centers of their distribution are compared. It must be admitted that intermediate forms are not altogether lacking. Intermediate forms between *Achillea Millefolium* and *A. Millefolium nigrescens* have been collected in Newfoundland. In northern New England *A. Millefolium* seems to be the only species. In New York, New Jersey, and Pennsylvania, both this and *A. occidentalis* are found, but intermediate forms seem to be very rare. In the center of distribution of *A. occidentalis*, viz., in Wisconsin, Illinois, Iowa, and Kentucky, *A. Millefolium* seems to be unknown, while in the north it has been collected in Manitoba, Saskatchewan, Alberta, and even British Columbia. It has been found also in Colorado; but judging from the localities, these specimens might have been escapes from cultivation. I have seen yarrows planted around miners' cabins. From Colorado and Nebraska I have seen a few specimens that were somewhat intermediate between *Achillea occidentalis* and *A. lanulosa*, but in almost every case they could be referred either to one or the other. *A. lanulosa* and *A. subalpina* both belong to the Rockies, but they grow at different altitudes; the former grows also on hillsides of the Great Plain region and at an altitude of 1000–3500 m.; the latter only in the high mountains at an altitude of 3000–4000 m. Hence at an altitude of 3000–3500 m., they are both found. Here intermediate forms might be expected. In California both *Achillea lanulosa* and *A. californica* are found, but

I have seen no intermediate forms. There are several specimens from Utah, Idaho, and Washington which I refer to *A. lanulosa*, though they approach *A. californica* in the stoutness of the plant and the larger heads. From Washington I have seen a specimen intermediate between *Achillea californica* and *A. borealis* and another between *A. arenicola* and *A. borealis*. *Achillea borealis* is not found in the Rockies within the United States and *A. subalpina* not in British America outside of the Rockies. The only specimen which I refer to *A. borealis* though approaching *A. subalpina*, is from the Canadian Rockies of Alberta.

Petasites corymbosa (R. Br.) Rydb. comb. nov.

Tussilago corymbosa R. Br. in Chloris Melv. 21. 1823.

Petasites palmata frigida Macoun, Cat. Canad. Pl. 1: 553. 1886. Not *P. frigida* (L.) Fries. 1845.

This has been included in *Petasites frigida* (L.) Fries, but differs in the deeply lobed leaves, the lobing extending one third to one half the distance to the midrib. It is the more common plant of the Canadian Rockies, known as *P. frigida*.

ARNICA

This genus, as represented in western North America is one of the most perplexing, and the last word concerning it is far from being said. I doubt if all the species proposed by Dr. Greene and Professor A. Nelson can be maintained. One of my own, *Arnica monocephala*, must be regarded as a low broad-leaved form of *A. pedunculata*, and *A. tenuis* Rydb. might be an entire-leaved and monocephalous form of *A. Rydbergii* Greene. On the other hand there are evidently forms of this genus that have not been described.

Considerable confusion has existed in regard to *Arnica Chamissonis* Lessing and *A. mollis* Hook. Gray in his Synoptical Flora united the two. In the old Torrey herbarium there are two specimens. One of these bears the printed label "*Arnica Chamissonis* Lessing, Unalaschka" and was received from St. Petersburg. It is evidently from the original collection. It is a plant of the *A. foliosa* group, with longer loose villous pubescence. We have several specimens similar to it from British Columbia, Alberta, and Saskatchewan and at least one from Mon-

tana. The other specimen is a duplicate of the type of *A. mollis*, received from Hooker. This is almost identical with *A. subplumosa* Greene, or *A. Chamissonis longinodosa* A. Nels., except that the involucral bracts are broader, oblanceolate, and abruptly short-acuminate. It represents a plant not uncommon in the Rockies, from northern Wyoming northward. The *Arnica* that is not uncommon in New England was referred to *A. Chamissonis* in Gray's Manual, 6th edition, and to *A. mollis* by Robinson & Fernald in the Gray's New Manual. It has nothing to do with the former. It is related to the latter, but is, I think, distinct enough. It has more affinity to *A. amplexifolia* Rydb. (*A. amplexicaulis* Nutt.) and *A. rivularis* Greene than to *A. mollis* Hook. It does not have the broad bracts of *A. mollis*. It should be known as *Arnica lanceolata* Nutt. A duplicate of the type (if not the actual type) of the last named is found in the Torrey herbarium.

What Professor Nelson had in mind as *Arnica mollis* when preparing the manuscript of the New Manual, I can not imagine. In his key he separates it from *Arnica subplumosa* by the "leaf blades decurrent on the petioles." The blades are slightly and but slightly decurrent in both. His description is very vague and evidently drawn from several species. As synonyms he cites "*A. Chamissonis* in part, but mostly *A. latifolia* as to our range (*A. latifolia* A. Gray, Bot. Calif. **1**: 415. 1885; *A. tomentulosa* Rydb. *loc. cit.* **28**: 20. 1901)." It is true that Gray and others referred *A. mollis* to *A. Chamissonis*, but I do not know that it has been referred to *A. latifolia*, unless by Prof. Nelson. *Arnica latifolia* A. Gray in the Botany of California comprises *A. latifolia* Bong., *A. Menziesii* Hook. (this perhaps not specifically distinct from *A. latifolia*) and *A. diversifolia* Greene (*A. latifolia viscidula* A. Gray). None of them has anything to do with *A. mollis*. *A. tomentulosa* Rydb. is related to *A. Chamissonis* Less., but differs in the short pubescence and the broad involucral bracts, rounded at the apex. If the form of the bracts should happen to be a variable character and of no specific value, Nelson's own *Arnica rhizomata* should be reduced to a synonym of *A. tomentulosa*, as there are practically no important differences except the form of the bracts and the latter name is nearly five months older.

Greene's idea of *Arnica Chamissonis* is also wrong. He states

under *A. columbiana*: "It can not be referred to *A. Chamissonis*, since it lacks the distinctly obovate leaf-cut, the broad, short disk-corollas and the tawny subplumose pappus of that species." These characters belong to *A. mollis*, not to *A. Chamissonis*.

There are more exceptions to be made to the treatment in the New Manual. Under *Arnica ventorum* Greene are given as synonyms *A. platyphylla* A. Nels. and *A. grandiflora* Greene. I have not seen the type of *A. platyphylla*, but *A. grandiflora* Greene is closely related to *A. cordifolia* Hook., and is not of the *A. latifolia* group. One specimen collected by R. S. Williams and referred to *A. platyphylla* by Nelson in his original publication is exactly like a specimen sent to Dr. Torrey as *A. Menziesii* by Dr. Hooker and included by him in his Flora. Both of these are very close to the original *Arnica latifolia* Bong., of which there is a duplicate in the Torrey herbarium. The only essential difference is that *A. latifolia* has perfectly glabrous achenes, while in *A. Menziesii* and Williams' plant the achenes have a few scattered hairs toward the upper end and are sparingly glandular-granuliferous.

Arnica sylvatica Greene is made a variety of *A. subplumosa*, and specimens distributed from the University of Wyoming under the name *Arnica subplumosa sylvatica* are nothing but a low-stemmed *A. subplumosa*. But the original *A. sylvatica*, of which there are two duplicates in the herbarium of the New York Botanical Garden, is quite different. It has cordate basal leaves and coarsely and saliently toothed stem-leaves. It is related to *A. diversifolia* Greene (*A. latifolia viscidula* A. Gray).

Professor Nelson has also united *Arnica fulgens* Pursh and *A. pedunculata* Rydb. What the original *A. fulgens* was, I do not really know, as I have not seen Bradbury's specimen; but *A. fulgens*, as interpreted by myself and by Piper,* has a horizontal slender rootstock, without any tufts of brown hairs, while *A. pedunculata*, including *A. monocephala* Rydb., is characterized by its short, thick, almost erect rootstock, with dark brown hair-tufts in the manner of *Plantago eriopoda*. It is the only species in North America that has this character, so far as I know.

*Contr. U. S. Nat. Herb. 11: 590 and 592.

Arnica caudata Rydb. sp. nov.

Perennial, with a short cespitose rootstock; stems 2–3 dm. high, leafy, villous, and densely glandular-puberulent; leaves nearly erect, linear-lanceolate, mostly sheathing at the base, densely glandular-puberulent and with scattered villous hairs, 5–10 cm. long, 5–8 mm. broad, caudate-attenuate at the apex, with entire, somewhat revolute margins; heads mostly 3, cymose, with the lateral peduncles usually exceeding the terminal one; involucres turbinate, about 1 cm. high, glandular-puberulent and hirsute; bracts linear-lanceolate, almost subulate, attenuate; ligules nearly 1 cm. long, 1–1.5 mm. broad, deeply toothed or cleft; achenes slender, cylindric, glandular-granuliferous, and sparingly hispidulous; pappus short, sordid, plumose; corollas more or less pubescent.

This species is perhaps related to *Arnica longifolia* but is easily distinguished by the low habit, the caudate-attenuate leaves, and the hirsute as well as glandular-puberulent bracts.

UTAH: Big Cottonwood Cañon, near Lake Catherine, Aug. 3, 1905, alt. 9300 ft., *A. O. Garrett 1547* (type, in herb. N. Y. Bot. Gard.).

SENECIO

The original *Senecio Bigelovii* was collected by Bigelow on the Whipple Expedition and a specimen is in the herbarium of Columbia University. It differs from all that have been known under that name in later years by the lower leaves having long petioles and ovate-lanceolate blades. The petioles are longer than the blades, and the latter are abruptly contracted below. In *S. chloranthus* Greene and *S. contristatus* Greene the basal leaves have comparatively short petioles, and the blades taper gradually below. These two species, which it may be, should be united in one, are therefore fully as distinct from *S. Bigelovii* as is *S. scopulinus* Greene. The latter is acknowledged as a variety in Coulter & Nelson's New Manual under the name *S. Bigelovii Hallii* A. Gray. It is in reality much closer to *S. chloranthus* than either is to *S. Bigelovii.* Dr. Greene* in proposing *S. scopulinus* says: "True *Bigelovii* is still unknown except from southern New Mexico, and is of very different aspect, with thin and not at all succulent deep-green herbage, usually no trace of any pubescence,

*Pittonia 4: 117–118.

but consisting of short stiff straight hairs whenever present. This, the real *S. Bigelovii*, was distributed by Mr. Wooton, from the White Mountains of New Mexico, as *S. Rusbyi*, an error for which I am solely responsible. The species is nearer to *S. Rusbyi* than it is to *S. scopulinus*, which latter I have until recently assumed to be the typical *S. Bigelovii*." These statements of Greene are correct in as far as that the specimens distributed by Wooton and referred to by Greene are the most like the original *S. Bigelovii* of any that we have in the herbarium of the New York Botanical Garden, but Wooton's specimens have narrow leaves, the blades of the basal ones are not abruptly contracted at the bases, and the heads are smaller than in *S. scopulinus*, while those of the type of *S. Bigelovii* are much larger, even larger than those of *S. contristatus*.

The treatment of *Senecio* in the New Manual of the Botany of the Central Rocky Mountains is fairly good. There are many cases, however, in which the authors have reduced species to synonymy under closely related species, where the writer is inclined to keep them distinct, but where this is merely a matter of difference of opinion. But there are other cases in which such reductions are wholly unwarranted, misleading, and destructive to real science. Such a case for instance, is where *Senecio solitarius* Rydb. is made a synonym of *S. subnudus* DC. A mere reading of the description of the former would show that it is related to the group comprising *S. integrifolius* Nutt., *S. columbianus* Greene, *S. perplexus* A. Nels. etc., while *S. subnudus* is related to *S. aureus*. Another case is where *Senecio Flintii* Rydb. is made a synonym of *S. glaucescens* Rydb. The former is closely related to *S. exaltatus* Nutt. and has a short crown with fascicled roots, characteristic of the *S. integrifolius* group, while *S. glaucescens* has a distinct rootstock, and is related to *S. anacletus* Greene.

Under *Senecio perplexus* A. Nels. we find the following statement: "(*S. columbianus* Rydb. in Fl. Col., not *S. columbianus* Greene, of which *S. atriapiculatus* Rydb. is a synonym.)" The true typical *Senecio columbianus* Greene is found in Colorado and not uncommon. The only question in my mind is whether *S. perplexus* A. Nels. is really specifically distinct. The only

difference is the more distinct toothing of the leaves of the former and the tendency of the upper stem-leaves to be narrower and more distinctly auriculate-clasping. *S. columbianus* and *S. perplexus* are really more closely related to each other than *S. dispar* A. Nels. is to *S. perplexus*, of which Professor Nelson has made it a variety.

Both *Senecio Harbourii* Rydb. and *S. Howellii* Greene have been made synonyms of *S. canus*. Before I published the former I visited the Gray Herbarium and had a conference with Dr. Greenman. I found that two of the species I had in manuscript he also intended to publish, viz., *S. Harbourii* Rydb. and *S. multicapitatus* Greenm. I published the latter under Greenman's name, and retained my own for the former. *S. multicapitatus* Greenm., Professor Nelson reduces to a synonym of *S. Riddellii* T. & G. I know that at least a few years ago, Dr. Greenman, our best student of *Senecio*, regarded both *S. Harbourii* and *S. multicapitatus* as good species. In Piper's Flora of Washington,* *S. Howellii* is kept distinct from *S. canus*. The manuscript of the genus was prepared by the aid of Dr. Greenman.

Senecio salicinus Rydb., *S. canovirens* Rydb., and *S. lanatifolius* Osterhout are given as synonyms of *S. Fendleri*. *S. salicinus* is more closely related to *S. rosulatus* Rydb. than to *S. Fendleri*. The other two are somewhat related to *S. Fendleri* but I think perfectly distinct, having an altogether different foliage. *S. lanatifolius* has besides discoid heads.

Regarding *Senecio rosulatus* Rydb., I may say that when that species was proposed we had but one sheet of *S. Nelsonii* and that not a duplicate of the type. This sheet bears two undeveloped plants, one of them evidently belonging to the variety *uintahensis*. My conception of *S. Nelsonii* was therefore rather *S. uintahensis* A. Nels. I am willing therefore to accept *S. rosulatus* as a synonym.

Senecio uintahensis A. Nels. is related to *S. multilobatus* T. & G., as Nelson indicates; but the latter is not a winter annual or biennial, but a perennial with a tap-root, just as *S. uintahensis* is.† The main differences are that *S. multilobatus* is more glabrous,

*Contr. U. S. Nat. Herb. 11: 599.

†See Bull. Torrey Club 27: 170 and 172.

has narrower divisions to the stem-leaves, and has hispidulous instead of glabrous achenes.

Under *Senecio cymbalarioides* Nutt., in the New Manual is given the following: "(*S. Jonesii*, S. *subcuneatus*, *S. acutidens* Rydb. * * * and *S. oodes* Rydb. * * * seem to be impossible to discriminate satisfactorily)." *S. subcuneatus* and *S. acutidens*, especially the latter, are closely related to *S. cymbalarioides*, but the others are not. *S. Jonesii* is more closely related to *S. uintahensis* than to *S. cymbalarioides* and is perhaps not specifically distinct. If not, *S. Jonesii* is the older name and should be used.

Senecio Hartianus Heller is given as a synonym of *S. pseudaureus* Rydb. Professor Nelson may have been led astray by myself, for the specimens referred to *S. Hartianus* in my Flora of Colorado are but depauperate specimens of *S. pseudaureus*. The true *S. Hartianus* is closely related to *S. flavulus* Greene.

Senecio pyrrochrous Greene and *S. Tracyi* Rydb. are made synonyms of *S. longipetiolatus* Rydb. They are both more related to *S. pseudaureus*, having cordate or reniform, although entire, basal leaves, while in *S. longipetiolatus* the basal leaves are narrow and oblanceolate, tapering into the petioles.

Senecio fediifolius Rydb. and *S. nephrophyllus* Rydb. are made synonyms of *S. discoideus* (Hook.) Britton, perhaps because all three have usually discoid heads. The original descriptions show that they are entirely different plants. *S. discoideus* should be replaced by *S. pauciflorus* Pursh, which is an older name. Greenman and Blankinship* think that *S. nephrophyllus* is the same as *S. debilis* Nutt. I have not seen the type of the latter and can not express any opinion.

Dr. Greenman some years ago called my attention to the fact that the plant usually known as *Senecio eremophilus* Richardson, does not agree with the original. There is a duplicate of the latter in the Columbia University herbarium and it differs from the Colorado plant in the larger heads, which are 10–12 mm. high and about 1 cm. wide and ascending or spreading instead of erect. In the Colorado plant the heads are less than 1 cm. high. *S. eremophilus* is a northern plant, its range extending from Manitoba to

*See Supplement to the Flora of Montana 102.

North Dakota, Montana, and northward far down the Mackenzie. Dr. Greenman thought that the Colorado plant should be referred to *S. MacDougalii* Heller, and so I adopted that view in the Flora of Colorado. I have seen two specimens from Colorado which may be included in *S. MacDougalii*, but the rest belong to what I think should be recognized as a distinct species.

Senecio ambrosioides sp. nov.

Senecio eremophilus Porter & Coulter, Syn. Fl. Colo. 82, mainly. 1874. Not *S. eremophilus* Richards.

Senecio MacDougalii Rydb. Fl. Colo. 397. 1906. Not *S. MacDougalii* Heller. 1899.

Perennial, with a stout rootstock; stem glabrous, leafy, 4–10 dm. high; leaves lanceolate or oblanceolate in outline, pinnatifid to near the midrib or the lower incised, glabrous, all except the uppermost short-petioled, the lobes lanceolate, coarsely dentate or incised; heads numerous, corymbose-paniculate, 9–10 mm. high, erect; involucres glabrous, 6 mm. high and about as broad; bracts carinate, linear, acute, with black tips, the calyculate ones subulate, 4–5 mm. long; ligules light yellow, 5–6 mm. long, 1.5–2 mm. wide; achenes minutely scabrous-puberulent on the angles.

This species differs from *Senecio MacDougalii* in the larger heads (in *S. MacDougalii* only about 7 mm. high), more campanulate involucres, lanceolate instead of linear divisions of the leaves, and the achenes scabrous-puberulent on the angles. From *S. eremophilus* it differs in the smaller and erect heads (in *S. eremophilus* 10–12 mm. high), shorter rays, and smaller leaves. *S. ambrosioides* grows in damp places at an altitude of 1800–3000 m.

COLORADO: Green Mountain Falls, El Paso County, Aug. 2, 1892, *C. S. Sheldon* (type, in herb. N. Y. Bot. Gard.); above Beaver Creek, July 8, 1896, *Crandall 3030;* Pagosa Peak, 1899, *Baker 706;* Parrott City, 1898, *Baker, Earle & Tracy 475;* Ute Pass, 1896, *Clements 190;* Colorado Springs, July, 1893, *Saunders;* Parlin, Aug. 16, 1901, *B. H. Smith 127;* Ruston Park, 1901, *Clements 152;* Mesa Yempa, 1898, *Shear 3943;* Chambers Lake, 1896, *Baker;* Ute Pass, 1896, *Shear 3695;* mountains between Sunshine and Ward, 1902, *Tweedy 4863;* Empire, 1903, *Tweedy 5783;* Silver Plume, 1895, *Shear 4999;* La Veta, 1896, *Clements 166;* Silver Plume, *1894, E. A. Bessey;* Georgetown, 1878, *M. E. Jones 728;* Gunnison, 1901, *Baker 596.*

WYOMING: Bridger Peak, 1903, *Goodding 1942;* between Sheridan and Buffalo, 1900, *Tweedy 3034;* Upper Buffalo Fork, 1899, *C. C. Curtis;* Centennial Mountain, Albany Co., 1902, *Aven Nelson 8773;* also 1900, *7719;* Copperton, 1901, *Tweedy 4136;* Eastern slope of Big Horn Mountains, 1900, *Tweedy 3033.*

NEW MEXICO: Mineral Creek, 1904, *Metcalfe 1415;* Santa Fé Cañon, 1897, *Heller 3819.*

Senecio Kingii sp. nov.

Senecio eremophilus D. C. Eat., Bot. King's Exp. 191. 1871. Not *S. eremophilus* Richards. 1823.

Perennial, with a thick rootstock; stems glabrous, 3–6 dm. high, rather stout, leafy; leaves obovate or oblanceolate in outline, 4–7 cm. long, the lower petioled, all pinnately lobed one third to one half the distance to the midrib, with ovate or lanceolate, more or less toothed lobes; heads numerous, corymbose-paniculate, 9–11 mm. high; involucres glabrous, campanulate, 7–8 mm. high, 6–7 mm. broad; bracts linear, acute, carinate, sometimes with small black tips; the calyculate ones few, subulate; rays 5–7 mm. long; achenes scabrous-papillose on the rounded angles.

This species is related to *S. eremophilus*, but differs in the somewhat smaller and erect heads, less deeply dissected leaves, and their broad and short divisions, and shorter rays. One of the specimens cited below was determined some years ago as *S. glaucifolius*, but that species differs from this as well as from the rest of the group in the narrower and scarcely carinate bracts.

UTAH: Cottonwood Cañon, Aug. 1869, *S. Watson 676* (type, in herb. Columbia University); Alta, Wahsatch Mountains, 1879, *M. E. Jones 1144;* American Fork Cañon, July 1895, *M. E. Jones;* Big Cottonwood Cañon, Aug. 1905, *Garrett 1591;* near Marysvale, 1905, *Rydberg & Carlton 7068;* Mount Barrette, *7206;* Fish Lake, *7506.*

Senecio Leonardi sp. nov.

Perennial, with a short rootstock; stem 4–5 dm. high, loosely floccose; basal leaves long-petioled; petioles 5–15 cm. long; blades obovate or oval, 2–6 cm. long, densely crenate, rather thick, loosely floccose, or in age glabrate, rounded at the apex; lower stem-leaves similar but with shorter petioles, the middle ones more or less lyrate-pinnatifid at the base; upper stem-leaves 1–3 cm. long, lanceolate in outline, pinnately lobed and somewhat

auriculate-clasping; heads in a rather dense corymb, 8–9 mm. high; involucres somewhat turbinate and floccose at the base, 5–6 mm. high, 6–7 mm. broad; bracts linear, acute, carinate, brownish-black on the backs, yellowish brown on the margins; rays orange, about 6 mm. long, 2 mm. wide; achenes glabrous.

This species resembles most the eastern *Senecio tomentosus* in habit and pubescence, but differs in the shorter blades of the basal leaves, which are obovate or oval instead of ovate, in the dark involucres, and the glabrous achenes. It grows in meadows at an altitude of 1500–2000 m.

UTAH: Near divide, head of American Fork Cañon, July 29, 1885, *Leonard 143* (type, in herb. N. Y. Bot. Gard.); Wahsatch County, near Midway, July 6, 1905, *Carlton & Garrett 6701*.

Senecio Tweedyi sp. nov.

Senecio flavovirens Rydb. Bull. Torrey Club **27**: 181, in part. 1900.

Senecio Balsamitae A. Nels., Coult. & Nels. New Man. Cent. Rocky Mts. 583, in part. 1909.

Perennial, with a rootstock; stem glabrous, or slightly floccose at the leaf-axils, 4–6 dm. high, striate; basal leaves 3–15 cm. long, petioled; blades elliptic or oval to oblanceolate, crenate-dentate, often lyrate-pinnatifid with a few lobes below the large terminal one; lower stem-leaves similar, but more pinnatifid; upper stem-leaves deeply pinnatifid, with oblong toothed divisions; heads corymbose, 9–10 mm. high; involucres glabrous, somewhat turbinate at the base, about 8 mm. high and as broad; rays narrow, bright yellow, 8–10 mm. long and a little over 1 mm. wide; achenes hispidulous on the margins.

This species has been mistaken for *Senecio flavulus* Greene (*S. flavovirens* Rydb.). In fact, the type was included in the original publication of *S. flavovirens* and the characters of the achenes were drawn from it. The type of *S. flavovirens* is just in bloom and the achenes only slightly developed, but a closer investigation shows that they are perfectly glabrous. So are the young achenes of all the specimens cited under *S. flavovirens* except *Tweedy 586*. As this had well-developed achenes, I unfortunately described the achenes from it. The type of *S. flavovirens* and the other specimens cited under it, with the single exception mentioned, belong to *S. flavulus* Greene, described a few months earlier. Be-

sides the difference in the achenes, *Tweedy 586* has longer and narrower rays and more deeply dissected stem-leaves than has *S. flavulus*. Since the publication of *S. flavovirens* we have received more specimens with long and narrow rays, but otherwise resembling closely *S. flavulus*. All these specimens have also hispidulous achenes.

WYOMING: Buffalo Fork, Aug. 1897, *Tweedy 586* (type, in herb. N. Y. Bot. Gard.); Snake River, Aug. 12, 1899, *Aven Nelson & Elias Nelson 6402*; headwaters of Clear Creek and Crazy Woman River, 1900, *Tweedy 3031;* low ground, Adams Ranch, Jackson's Hole, July 15, 1901, *Merrill & Wilcox, 967*.

MONTANA: Lima, June 30, 1895, *Shear 3409*.

The following species described from within the range of the New Manual or known to exist therein are not accounted for at all in that publication: *S. seridophyllus* Greene, *S. lanceolatus* T. &. G., *S. pereziifolius* Rydb., *S. neomexicanus* A. Gray, *S. laramiensis* A. Nels., *S. Hallii* Britton, *S. exaltatus* Nutt., *S. Scribneri* Rydb., *S. Porteri* Greene, *S. alpicola* Rydb., *S. turbinatus* Rydb., *S. pentadontus* Greene, *S. cognatus* Greene, and *S. Wardii* Greene.

Greene and Greenman regard *Senecio altus* Rydb. as a synonym of *S. sphaerocephalus* Greene, and I think that *S. perennans* A. Nels. is but a broad-leaved form of *S. werneriaefolius* A. Gray.

Blankinship in his Supplement to the Flora of Montana adopts *Senecio saxosus* Klatt, giving under it the synonyms: *S. petraeus* Klatt, *S. petrocallis* Greene, and *S. alpicola* Rydb. I can not find that *S. saxosus* Klatt was ever published. *S. petraeus* Klatt, or *S. petrocallis* Greene, is not found in Montana and *S. alpicola* is well distinct, being more closely related to *S. werneriaefolius* than to *S. petrocallis*.

TETRADYMIA

In the New Manual, *Tetradymia multicaulis* A. Nels. and *T. linearis* Rydb. are given as synonyms of *T. inermis* Nutt. The first I regard as a low depauperate form of *T. inermis*, but the second can not well be reduced to a synonym thereof. It is somewhat intermediate between *Tetradymia canescens* and *T. glabrata*. Except in the early spring it bears fasciculate leaves, as does *T.*

glabrata, but these leaves are more tomentose. The primary leaves are neither erect nor subulate and somewhat spine-like as they are in *T. glabrata*. It differs from *T. canescens* in the narrower, more or less falcate primary leaves and the presence of secondary fasciculate ones.

Tetradymia longispina (M. E. Jones) Rydb. comb. nov.

Tetradymia spinosa longispina M. E. Jones, Proc. Calif. Acad. Sci. II. **5**: 698. 1895.

This I think deserves specific rank.

NEW YORK BOTANICAL GARDEN.

Cienfuegosia Drummondii, a rare Texas plant

FREDERICK L. LEWTON

Several years ago, while collecting in western Texas, the writer's attention was attracted by a note in Coulter's Botany of Western Texas in reference to a malvaceous plant, *Fugosia Drummondii* Gray. "Found in Gonzales County many years ago by Drummond, but, so far as known, not since found."

Being engaged in field experiments with cotton for the United States Department of Agriculture, the rarity of this close relative of the cotton plant aroused a desire to discover it again, and during the past four years the plant has been kept in mind and sought for pretty generally throughout southwestern Texas.

Consultation of the United States National Herbarium revealed the fact that the single North American specimen of this plant there preserved was obtained by that indefatigable collector of western plants, A. A. Heller, at Corpus Christi, Texas, in 1894. Of this find he says:

"In rich black land on the edge of a water hole near the Arroyo, Corpus Christi, altitude 40 feet. Very few plants were seen, and only one in flower, but the others in good fruit. Flowers almost two inches in diameter, greenish yellow. Apparently a very rare plant."*

With this clue the writer carefully investigated the locality mentioned in July, 1909, but found no traces of the plant.

A species of *Sida* having leaves closely resembling those of the plant sought was eagerly gathered many times in the belief that the quest was ended, but a closer examination showed that it belonged to the opposite end of the mallow family from that of *Fugosia*.

On June 15, 1910, the four-year search was rewarded by finding several plants of this rare species in flourishing condition in a

*Contr. Herb. Franklin & Marshall College, no. 1: 67. 1895.

cotton field belonging to the Coleman-Fulton Pasture Company at Taft, Texas. This is a rapidly developing town in San Patricio County, located on the San Antonio & Aransas Pass Railway between Sinton, the county seat, and Gregory, the junction with the Rockport branch of the railroad. The first plant found was all but buried in the soil, the field having been cultivated a few days before.

This plant was subsequently found to be plentiful at Taft, in the fields, where it can escape the agricultural implements, around the margins of the irrigating tanks, and along the banks of the roadside ditches. Its large sulphur-yellow flowers tinged with green make it a conspicuous object when in bloom.

According to Small* and Heller† this plant is the same as the Brazilian plant described by Saint-Hilaire‡ under the name *Fugosia sulfurea*. Another student of this difficult genus, Hochreutiner, considers the Texan plant a variety of the Brazilian species and in an annotated list of the species of the genus§ labels it *Cienfuegosia sulphurea*, var. *Drummondii*.

The Brazilian species is evidently quite variable, however, and Gürke has described|| under the name of *Cienfuegosia sulphurea*, var. *glabra*, a variety which appears to be nearer Gray's *Fugosia Drummondii* than the typical *F. sulfurea*. Morong's *no. 929*, collected in Paraguay in February 1891, when compared with the Texas specimen, shows a larger, more erect plant; leaves more nearly round; curved and much shorter peduncles, having fewer, smaller and narrower involucral bracts and bearing smaller flowers, which have a "brown eye at the base inside." ¶

In the opinion of the writer the Texas plant differs from the Brazilian *Cienfuegosia sulfurea* (St. Hil.) Garcke by sufficient characters to warrant the restoration of Gray's specific name. These differences might be contrasted as follows:

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*Small, J. K. Flora Southeastern United States 777. 1903.

†Heller, A. A. Contr. Herb. Franklin & Marshall Coll. no. 1: 67. 1895.

‡Saint-Hilaire, A. Flora Brasiliae Meridionalis 1: 252. *pl. 49.* 1825.

§Hochreutiner, B. P. G. Ann. Conserv. et Jard. Bot. Genève 6: 57. 1902.

||Gürke, M. Martius, Flora Brasiliensis 12[3]: 577. 1892.

¶Morong, T. Ann. N. Y. Acad. Sci. 7: 60. 1892.

C. sulfurea	*C. Drummondii*
Plant pubescent.	Plant glabrous but for a few scattered stellate hairs on younger parts.
Stipules ovate.	Stipules linear-subulate.
Leaves subrotund, subcordate, less than 1 inch long.	Leaves oblong or obovate, 2 inches long.
Peduncles but little longer than the petioles.	Peduncles twice as long as the petioles or more.
Bracts of involucre 5–6, linear, 6–8 mm. long.	Bracts of involucre 8–10, spatulate, 10–20 mm. long.
Flowers with brown or purple center.	Flowers without dark center, greenish yellow throughout.
Style exserted beyond the stamineal tube more than the length of the stamens.	Style but little exserted beyond the stamineal tube.
Capsules 3–4-celled, covered with black tuberculate glands.	Capsules 5- or rarely 4-celled; black glands not conspicuous.
Cells 1-seeded by abortion.	Cells 3–5-seeded.

The name for the Texas plant should thus be **Cienfuegosia Drummondii** (A. Gray) Lewton, comb. nov.

The synonymy is as follows:

Fugosia Drummondii A. Gray, Pl. Wright. **1**: 23. 1852.

Hibiscus Drummondii Kuntze, Rev. Gen. Pl. **1**: 67. 1892.

(?) *Cienfuegosia sulphurea*, var. *glabra* Gürke; Mart. Fl. Bras. **12**^{3}: 577. 1892.

Cienfuegosia sulphurea, var. *Drummondii* Hochreutiner, Ann. Conserv. et Jard. Bot. Genève **7**: 57. 1902.

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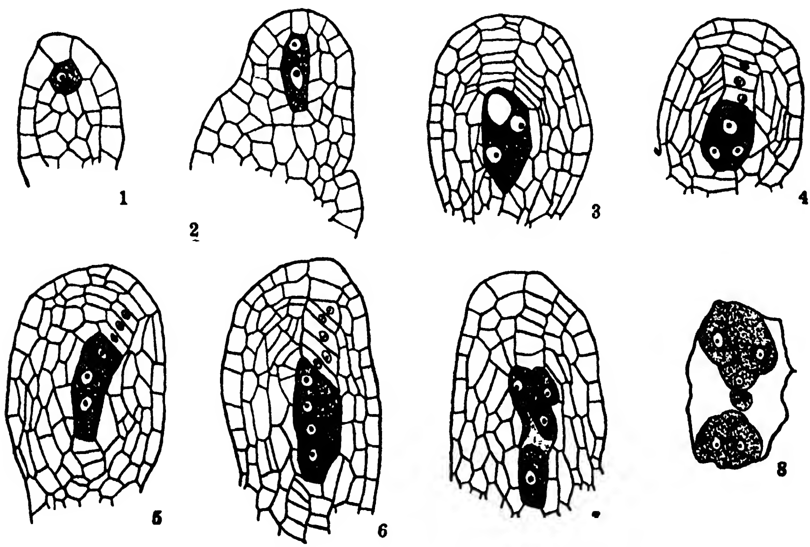
Development of the embryo-sac of Hybanthus concolor

FRANK M. ANDREWS

The embryo-sac of *Hybanthus concolor* (Forst.) Spreng. (*Cubelium concolor* Raf.) begins its development as an hypodermal cell. At first this cell is not different apparently from the other cells about it, but soon it becomes very grumous and is then easily distinguishable (FIG. 1).

The mother-cell of the embryo-sac next divides by a transverse wall into two cells unequal in size (FIG. 2). The terminal one of these two cells becomes somewhat more granular than the others and gives rise to the primary tapetal cell. By the rapid and nu-



FIGURES 1–8. Development of the embryo-sac of *Hybanthus concolor*. The figures are magnified 420 diameters. See text for explanations.

merous transverse divisions of this primary tapetal cell the embryo-sac when completely formed and sometimes even before maturity is covered by many layers of cells. Vertical as well as transverse divisions of the cells of the tapetal region also occur, so that frequently several quite regular rows of cells above the embryo-sac are produced (FIGS. 3, 4, 5, 6). Sometimes this regularity of these

divisions in the tapetal region is not shown. Instances were noticed where before and also after the formation of the primary tapetal cell the mother-cell of the embryo-sac divided longitudinally. These, however, in every instance divided into cells like those usually surrounding the embryo-sac mother-cell but were more granular.

The embryo-sac mother-cell divided first into two and then into four cells in the usual way. These divisions were often very irregular, as in some cases (FIG. 3) they were nearly vertical, and as shown by FIG. 4 were completely vertical after the first division.

The formation of the embryo-sac by the dissolution of these four cells generally begins with the lowest one of the tetrad and proceeds apically as regards the ovule through the other three. This is not always the case, for some instances were noticed in this same plant where the dissolution began with the next to the lowest cell of the tetrad as shown in FIG. 7. The embryo-sac, formed by the destruction of the tetrad as well as some of the surrounding cells, is very large.

The egg apparatus and antipodal cells in this plant are unusually large, as shown by FIG. 8. They frequently extend nearly across the embryo-sac lengthwise. The secondary nucleus was usually rather small.

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Other editions of Emory's Report, 1848

Oliver A. Farwell

In the Bulletin of the Torrey Botanical Club for September, 1895, Dr. Barnhart points out some differences in detail between the botanical portions of Executive Document No. 7, for the Senate, and Executive Document No. 41, for the House, the same being Lieut. W. H. Emory's Notes on a Military Reconnoissance. In the same journal, for the following March, Mr. F. V. Coville, in discussing the above paper, deduces from internal evidence that Ex. Doc. No. 41 was published earlier in 1848 than Ex. Doc. No. 7. Mr. Coville also mentions a third edition, by H. Long and Brother, of New York, which is an exact copy of Ex. Document No. 7 but paged differently.

It may be of interest to botanists to know that other editions have been published. In the library of Parke, Davis & Co., Detroit, Mich., there is a copy of each of both House and Senate documents which are different in some respects from those described by Dr. Barnhart and Mr. Coville. Judging from the remarks of Messrs. Barnhart and Coville on the subject of typographical errors in the earlier editions, I should imagine, from a careful perusal of these copies, that many of the earlier errors were corrected in these editions.

Executive Document No. 41 was published in 1848, according to the date of the title page. The character (7) appears on pages 17–32, inclusive, of Lieut. Emory's "Notes" instead of on pages 145–158 of the botanical portion as described by Dr. Barnhart. The full description of *Zinnia grandiflora* Nutt. is included and appears on page 144. In other respects it agrees with the edition described by Messrs. Barnhart and Coville.

The other copy is appendix No. 2, taken bodily from some report, but gives no evidence to indicate the report of which it formed a part or its date of publication. The page is somewhat smaller than that of Ex. Doc. No. 41 and the lines are double-spaced, but the body of the report is essentially the same; the

pagination is from 179 to 211, the figures appearing in the middle at the top of each page, and therefore is probably a second issue of edition 3 described by Mr. Coville and is Doc. No. 7; it differs from this however, in that the plates are those of C. B. Graham of Washington, D. C., and plate VI is labeled *Baileya multiflora* instead of *B. multiradiata.* It includes *Convolvulus Nuttallii* and *Alternanthera?* (*Endotheca*) *lanuginosa,* which are not in Doc. No. 41. *Cereus gigantens* of the latter becomes *C. giganteus* in the former; *E.* [*Eriogonum*] *Aberteanum* n. sp. becomes *E. Abertianum* n. sp.; and *Stillengia spinulosa* n. sp. becomes *Stillingia spinulosa* n. sp. Also the concluding part of Dr. Engelmann's Report, matter pertaining to No. 15 and *Cereus giganteus,* is entirely rewritten. Prof. Torrey's report occupies pages 179–206; p. 207 is occupied by an explanation of plates; and on pages 208–211 appears Dr. Engelmann's report.

It would, therefore, appear that there are five editions of Lieut. Emory's Report, all of which probably were published in 1848: two of Ex. Doc. No. 41, one without a description of *Zinnia grandiflora* and one with it; three of Ex. Doc. No. 7, one with pagination the same as that of No. 41 and two with different pagination; of the latter, one has the plates of E. Weber & Co. and one has the plates of C. B. Graham; and all three differ from the second edition of No. 41 in including *Convolvulus Nuttallii* and *Alternanthera lanuginosa.*

DETROIT, MICHIGAN.

INDEX TO AMERICAN BOTANICAL LITERATURE
(1910)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

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BULLETIN

OF THE

TORREY BOTANICAL CLUB

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Notes on Rosaceae — IV

PER AXEL RYDBERG

POTENTILLA (*continued*)*

PERMOLLES

This group contains only one species, *Potentilla permollis* Rydb. Dr. Wolf reduced this to a variety of *P. Blaschkeana*, evidently without having seen any specimen. It has a pubescence wholly unlike any species in the GRACILES or the NUTTALLIANAE groups, and although somewhat related to these, I regard it as distinct enough to be placed in a group by itself. Piper, who is rather conservative in his treatment, regards it as distinct in his Flora of Washington,† and cites three specimens.

CANDIDAE

This group contains six species, of which four are proposed as new. These are *Potentilla Elmeri*, *P. Pecten*, *P. subvillosa*, and *P. comosa*. Of these, the last one is related to *P. Bakeri*, and the rest to *P. candida*. *Potentilla Pecten* stands nearest to that species and differs mainly in the leaves, which are green above, and in the stem, which bears only a few small leaves. The following specimens belong to *P. Pecten:*

MONTANA: Bridger Mountains, 1897, *Rydberg & Bessey 4377*.

WYOMING: Cokerville, 1898, *Aven Nelson 4647;* Union Pass, *Aven Nelson 943*.

*See Bull. Torrey Club 37: 375–386.

†Contr. U. S. Nat. Herb. vol. 11.

[The BULLETIN for September, 1910 (37 : 443–486) was issued 5 O 1910.]

UTAH: Big Cottonwood Cañon, 1905, *Garrett 1614*.

Potentilla Elmeri resembles *P. Pecten* in habit but is silky, not at all tomentose. It is represented by the following:

CALIFORNIA: Griffins, Ventura County, 1902, *Elmer 4009;* Donner Lake, 1903, *Heller*.

Potentilla subvillosa and *P. comosa* are very local and are represented by the type collections only.

Dr. Wolf in his monograph and Professor Aven Nelson in the New Manual of Botany of the Central Rocky Mountains unite *Potentilla Bakeri* and *P. viridescens*, and the former reduces both to a variety of *P. gracilis*. *P. viridescens* is evidently related to *P. gracilis* and differs in the characters presented by Dr. Wolf; but *P. Bakeri* has the leaves dissected to near the midrib into linear or linear-oblong and obtuse, not lanceolate and acute divisions. *P. Bakeri* has spreading pubescence on the stem, and the leaves are rather densely tomentose beneath. I have collected *Potentilla Bakeri* myself in Utah and *P. viridescens* in Montana and know that they both hold their characters well. Besides the specimens cited by me in the original publication, the following represent *P. Bakeri*:

UTAH: Wahsatch County, near Midway, 1905, *Carlton & Garrett 6721* and *6696;* Juab, June 10, 1902, *Goodding 1092;* Big Cottonwood Cañon, Aug. 14, 1905, *Garrett 1614;* Hot Pots, Wahsatch County, *Garrett F726*.

WYOMING: Chug Creek, Albany Co., June 29, 1900, *Aven Nelson 7318* (not *7317*, which is cited by Dr. Wolf under *P. gracilis viridescens*).

PECTINISECTAE

This group contains four species, of which *Potentilla longiloba* is described as new. It resembles *P. Blaschkeana* in habit, but the leaves are loosely villous-tomentose above. The following specimens belong here:

MONTANA: Lo Lo, May 29, 1897, *Elrod and assistants 110;* Gallatin Valley, near Bozeman, 1896, *Flodman 563*, in part.

WASHINGTON: Pullman, June, 1903, *Piper 4134*.

BRITISH COLUMBIA: Near international boundary between Kettle and Columbia rivers, June 25, 1902, *Macoun 63901*.

IDAHO: Clear Water, *Spaulding*.

Dr. Wolf regards *Potentilla ctenophora* as a variety of *P. flabelliformis*, which was also my first idea, before I knew the plant better. Dr. Wolf makes some remarks which read in translation as follows: "The relationship of this variety to var. *typica* seems to me about the same as, for instance, that of *P. argentea* var. *decumbens* to its var. *typica*, and its elevation to specific rank seems to have been made on slight grounds, as the author himself in his monograph says that it should perhaps be regarded as a variety of *P. flabelliformis*, as intermediate forms are not lacking. Why has he not let it remain in its original category? It seems that he makes the limitations of his idea of a species narrower as the years pass by." This may be in a certain sense true, but it has been brought about by a study of many years and the characters stand out better and better as the plants become better known. In this special case Dr. Wolf's remarks were more or less amiss. I do not know what specimens he might have had at hand to support his statements. Neither in the original descriptions of *P. flabelliformis ctenophora* in the Bulletin of the Torrey Botanical Club nor in my monograph, did I cite any specimens. Unfortunately, I forgot to do so. The illustration in the monograph gives only a basal leaf. There is nothing to show the differences in general habit and the flowers. Professor Piper has directed my attention to the fact that my *P. ctenophora* is the same as *P. Blaschkeana* Lehm. Later he has also recorded his views on this point in his Flora of Washington. I agree fully with Professor Piper and have stated before that my conception of *P. Blaschkeana* was a composite one, mainly made up of *P. grosse-serrata*. Dr. Wolf, I think, did not make the same mistake, for his description points unmistakably to *P. Blaschkeana* Turcz., as described and illustrated by Lehmann, not as characterized in my monograph. After the citation of Lehmann's plate, Dr. Wolf gives in parenthesis "(*optima*)". His conception of *P. Blaschkeana* was therefore evidently correct. As my *P. ctenophora* is evidently the same, why should it not be regarded as specifically distinct from *P. flabelliformis*?

Professor Aven Nelson in the New Manual of Botany of the Central Rocky Mountains makes *P. Blaschkeana* a synonym of *P. gracilis* and *P. ctenophora* a synonym of *P. flabelliformis*.

GRACILES

The following species were described as new in the North American Flora: *Potentilla intermittens*, *P. alaskana*, *P. dichroa*, and *P. camporum*.

As stated in the North American Flora, *Potentilla intermittens* may be a hybrid between *P. glaucophylla* and *P. filipes*, so intermediate is it in every respect that a mere glance would suggest its hybrid origin. As I had no direct evidence, however, I proposed a specific name and described it, hoping that botanists might study it further in the field. The following specimens belong here:

COLORADO: Cameron Pass, 1896, *Baker 25;* Buffalo Pass, 1898, *Shear 3863*.

ALBERTA: Foothills, 1897, *Macoun 16722*.

Potentilla alaskana resembles *P. viridescens* in habit but the flowers are much larger, the petals being 9–14 mm. long, the bractlets linear instead of lanceolate, and the leaves densely tomentose beneath. It differs from *P. gracilis* in the lower stem and the appressed pubescence on stems and petioles. Several specimens have been seen, but all were from the Island of Kadiak, Alaska.

Potentilla dichroa is related to *P. glomerata* but differs in the dense white tomentum of the lower surface of the leaves. It differs from *P. gracilis* in the thicker leaves, and in the stouter and lower, more leafy stem, which is appressed-hairy. The following specimens belong here:

MONTANA: Old Sentinel, 1901, *MacDougal 185*.

OREGON: Burns, 1901, *Griffiths & Morris 766*.

The following I have referred here, although they are less typical specimens:

UTAH: Hot Pots, Wahsatch County, 1905, *Garrett F727*.

NEVADA: Washoe Valley, *Stretch 74*.

Potentilla camporum is somewhat intermediate between *P. gracilis* and *P. filipes*, having the toothing of the leaves of the former and the small flowers of the latter. It has much broader, thicker, and more pubescent leaves than the former, more coarsely toothed and more hairy leaves than the latter. The following specimens are referred here:

SOUTH DAKOTA: Black Hills, *Miss Pratt 93*

MANITOBA: Rapid City, 1896, *Macoun 14447* and *14450;* Fort Ellis, 1906, *Macoun & Herriot 68930.*

SASKATCHEWAN: Milk River, 1881, *Dawson 34348;* The Holes, 1885, *Macoun 10447;* Cypress Hills, 1894, *Macoun 4538;* Herzel, 1906, *Macoun & Herriot 69827;* Park Bay, 1896, *Macoun 14447;* Silver City, 1885, *Macoun 635* and *7284.*

BRITISH COLUMBIA: Slotch-oot-a Lake, 1876, *Dawson 7282;* Nicola Valley, *Macoun 7229;* Revelstoke, 1890, *Macoun 7287.*

In 1901, while visiting northern Europe, I found in the Botanical Garden at Upsala specimens of *Potentilla pulcherrima* Lehm., which had been cultivated for several generations since Lehmann's time and kept unchanged the characters of pinnate leaves, etc. Side by side were growing also specimens of the so-called *P. gracilis* from Colorado with its digitate leaves. The latter is of course not the true *P. gracilis* but the *P. pulcherrima* of my monograph or *P. pulcherrima communis* Th. Wolf. Seeing these two forms together, the suggestion came to me that they might not be one species. While collecting in Utah, I found *P. pulcherrima* in the same cañon where Dr. Watson had rediscovered it, viz., in the Big Cottonwood Cañon, southeast of Salt Lake City. Here it was growing alone. Numerous specimens were seen in an open place along the river, but no digitate-leaved specimens were seen. I have come to the conclusion that it is not a parallel case to *P. diversifolia,* in which the basal leaves are either pinnate or digitate or both on the same plant. In all specimens of *P. pulcherrima* proper, the basal leaves are all pinnate, while in *P. pulcherrima communis* they are all digitate. In 1901, I described a supposed new species under the name of *P. filipes,* which Dr. Wolf reduced to a variety of *P. pulcherrima.* I have found that the characters separating *P. filipes* and the so-called *P. pulcherrima* of Colorado do not hold. I therefore united the two into one species under the name of *P. filipes* in the North American Flora. A depauperate high-mountain form of this species is *P. pulcherrima condensata* Th. Wolf.

Professor Nelson in the New Manual of Botany of the Central Rocky Mountains makes not only *P. pulcherrima* and *P. filipes* but also *P. fastigiata* and *P. Blaschkeana* synonyms of *P. gracilis,* a consolidation which goes altogether too far.

LONGIPEDUNCULATAE

This section contains only one species, which Dr. Wolf makes a doubtful variety of *P. gracilis.*

SUBJUGAE

This group also contains only a single species, *Potentilla subjuga.* In my monograph, I included also in this group *P. quinquefolia*, a disposition which Dr. Simmons in the Flora of Ellesmere Land rightly criticizes. This species I transferred in the North American Flora to the CONCINNAE group.

SUBCORIACEAE

This group contains three species, all Mexican. Dr. Wolf calls the group RANUNCULOIDES and includes in it not only these three species, and the BREVIFOLIAE and SUBVISCOSAE groups, but also such diverse plants as *Potentilla Townsendii*, *P. Palmeri*, *P. Ranunculus*, *P. flabellifolia*, *P. fragiformis*, and *P. Sierrae-Blancae*, together with *P. acuminata*, which is a species with pinnate leaves related to *P. saxosa.*

OBOVATIFOLIAE

This group also is Mexican and Central American and consists of three species. The first of these, *P. staminea* Rydb., was until lately known only from the type collection by Ghiesbrecht. It has been collected also in Guatemala, in 1896, *Seler 2753.* If I am not mistaken, they are the same specimens that Dr. Wolf cites under *P. haematochrus* on page 226 of his monograph. A few years after its publication I referred to this species doubtfully *Pringle 6890.* This evidently was the reason why Dr. Wolf reduced *P. staminea* to a variety of *P. leptopetala* Lehm. *Pringle 6890* is evidently much more closely related to *P. leptopetala* than to *P. staminea.* I have been inclined to refer *Pringle 6890* and other material collected later in the same region to *P. leptopetala*, for they agree fairly well with Lehmann's description (except as to the size of the petals). If, however, Lehmann's figure in his Monographia, *pl. 43*, is correct, then the plant from which it was prawn must be of a different species from *Pringle 6890* or else it is a freak or in an abnormal condition. I have seen neither the type of

P. leptopetala, nor the plants collected by Schiede and by Ehrenberg, enumerated in Linnaea. From certain remarks there I have suspected that these specimens belonged rather to the same species as *Pringle 6890* than to the typical *P. leptopetala*. Dr. Wolf, on page 228 of his monograph, also states that these specimens agree very well with *Pringle 6890*. From this I may judge that Dr. Wolf's interpretation of my *P. staminea* is wrong and that his *P. leptopetala staminea* is the same as my *P. obovatifolia*, which was based on *Pringle 6890*. Dr. Wolf has committed another grave blunder, for on page 251 he reduces *P. obovatifolia* to a variety of *P. concinnaeformis*. Here he also cites *Pringle 6890*, overlooking the fact that he had already cited the same number under *P. leptopetala staminea*. When preparing the manuscript for page 228, he evidently had the specimen before him, while when doing the same for page 251, he made use of no specimens and simply made *P. obovatifolia* a variety of *P. concinnaeformis*, because of my statement that it was nearest *P. concinnaeformis* of the CONCINNAE group. From his treatment of *P. concinnaeformis*, it is evident that Dr. Wolf had seen no specimens of that species. All he had to go by was the short description and plate in my monograph. I think it rather audacious to reduce one species to a variety of another, without knowing material of either. The following specimens belong to *P. obovatifolia*:

MEXICO: Sierra de Pachuca, Hidalgo, 1898, *Pringle 6890;* also in 1902, *Pringle 9783;* Cuyamaloya, Hidalgo, 1906, *Pringle 10276.*

HORRIDAE

This group contains two Mexican species, known only from the type collections. *Potentilla horrida* is referred to the HAEMATOCHROAE group by Dr. Wolf, notwithstanding its yellow flowers. *P. durangensis* is described as new in the North American Flora.

RUBRAE

The oldest known species of this group is *Potentilla comarioides* Humb. & Bonp. Unfortunately this universally known name is antedated by one year by *P. rubra* Willd., which name must be adopted. The group contains seven species from northern Mexico and the southwestern United States. Of these, *P.*

madrensis is overlooked by Dr. Wolf. *P. sanguinea* is described as new in the North American Flora.

AUREAE

As treated in the North American Flora, this group contains nine North American species. If one follows Dr. Wolf in laying so much stress on the form of the style, all the American species, except *Potentilla maculata* and *P. Langeana*, should be excluded from the AUREAE group. In this group the styles should be somewhat thickened upward, instead of downward. In some species the styles are perfectly filiform, not thickened either way. The result is that a distinct line can not be drawn between the CONOSTYLAE and the GOMPHOSTYLAE of Dr. Wolf's monograph. In the AUREAE, Dr. Wolf has such diverse species as *Potentilla maculata*, *P. elegans*, *P. Robbinsiana*, and *P. gelida*. Of these, *P. Robbinsiana* at least does not have the styles thickened upwards. The RANUNCULOIDES group of Dr. Wolf is still worse. It contains not only the thick-leaved and thick-rhizomed Mexican and Central American species, of which it was made up in my treatment, and my SUBVISCOSAE and BREVIFOLIAE groups, but also such diverse species as *Potentilla acuminata* Hall (related to *P. saxosa*), *P. flabellifolia* Hook., *P. fragiformis* Willd., *P. Townsendii* Rydb., *P. Palmeri* Th. Wolf, and *P. Sierrae-Blancae* Rydb. *Potentilla emarginata* Pursh is placed with the AUREAE, while the closely related *P. fragiformis* is placed in RANUNCULOIDES. *P. gelida* Mey. is put in the former, and *P. flabelliformis* Hook., which S. Watson and other students of *Potentilla* have not been able to distinguish from it, is put in the latter group; *P. perdissecta* Rydb. or, as Dr. Wolf calls it, *P. diversifolia* var. *decurrens* (Wats.) Th. Wolf, is placed in the MULTIJUGAE, while *P. Ranunculus* Lange, which can be separated from it only by the different rootstock (see below), is placed in the RANUNCULOIDES. *P. Townsendii* and *P. Palmeri* and their relationship I have discussed before. Dr. Wolf's grouping in this case therefore is very artificial and unsatisfactory.

I think that the group as constituted by me is more natural, although it could be subdivided into three subgroups. *Potentilla Sierrae-Blancae* stands alone, is not so closely related to the rest,

and shows many affinities to the CONCINNAE, although it lacks tomentum.

Potentilla maculata and *P. Langeana* are closely related. Dr. Wolf adopts the name *P. alpestris* for the former, claiming that the name *P. maculata* Pourr. probably belongs to *P. pyrenaica* Ram. He does not, however, adopt the name *P. maculata* for the latter, although the name is much older. Dr. Wolf does not admit *P. Langeana* as a distinct species.

The rest of my AUREAE group are closely related. *Potentilla Vreelandii* Rydb. was first described in the North American Flora, and was consequently unknown to Dr. Wolf.

Potentilla diversifolia Lehm. is placed in the MULTIJUGAE group by Dr. Wolf, and under it he recognizes four varieties: *genuina, decurrens, glaucophylla*, and *jucunda*. It is true that *P. diversifolia* often has at least some of the leaves pinnate, although with closely approximate pairs of leaflets, and that it connects the MULTIJUGAE and the AUREAE groups. The forms regarded as varieties of it by Dr. Wolf have digitate leaves.

Concerning *Potentilla glaucophylla* Lehm., first described as a species and afterwards reduced to a variety of *P. diversifolia* by the author himself, it may be said that although it is very close to some forms of *P. diversifolia*, especially when they bear only digitate leaves, it seems to be more different in the living state than in dried material, and Professor Aven Nelson,* who also has had chance to study them in the field agrees with me in regarding them as distinct.

That Dr. Wolf reduced *Potentilla jucunda* to a variety is probably due to the fact that he had received unusually large specimens of *P. glaucophylla* which were labeled *P. jucunda*. See the remarks in my preceding Notes on Rosaceae.

What I actually described and figured in my monograph of *Potentilla* as *Potentilla decurrens*, was not the same as *P. dissecta decurrens* of S. Watson. My description was, however, made broad enough to include Watson's plant. In 1905, while collecting in Utah, I collected at several places a plant which I regarded as a new species. A closer comparison with Watson's type of *P. dissecta decurrens* (which is a rather poor specimen) revealed my

*See Coult. & Nels. New Man. Cent. Rocky Mts. 257.

mistake. *Potentilla decurrens* of my monograph, and as understood by A. Nelson, *loc. cit.*, or *A. diversifolia* var. *decurrens* Th. Wolf, mainly, is not the same as Watson's plant. It is a plant related to *P. glaucophylla* and *P. Ranunculus*, while the original *P. dissecta decurrens* is related to *P. ovina* J. M. Macoun. In the North American Flora, the former is described under the name *P. perdissecta*.

Potentilla Ranunculus Lange, which Dr. Wolf associates with *P. ranunculoides* H. B. K., is not related to that species but to the one just discussed above and to *P. glaucophylla*. It is hard to distinguish it from these species except by the rootstock, which in *P. Ranunculus* is much branched and creeping and densely covered with scales. This character is found in many arctic plants and is perhaps due to the climatic conditions. *P. Ranunculus* has usually broader leaflets than *P. glaucophylla* and they are less dissected than in *P. perdissecta*.

Potentilla multisecta (S. Wats.) Rydb. is closely related to *P. perdissecta*. Dr. Wolf reduces it back to a variety of *P. dissecta*, as it was originally described by S. Watson. This is really a transfer to another species, for *P. dissecta* of Watson was not the same as *P. dissecta* Pursh, but was *P. diversifolia* Lehm. This transfer is made, although Dr. Wolf expressly states that he has not seen *P. dissecta* Pursh. Professor Nelson, *loc. cit.*, has omitted this species, although it has been collected in Wyoming.

SUBVISCOSAE

Very little can be said about this group, as little material has been received since my monograph and few new facts have been brought to light since that time. Through further study of *Potentilla Wheeleri viscidula*, I have come to the conclusion that it deserves specific rank and it is given such in the North American Flora. Dr. Wolf has made no change in the species of this group, as he had seen specimens of only *P. Wheeleri*. As stated before, he includes the whole group in his RANUNCULOIDES.

CONCINNAE

This group has been a little modified from the treatment in my monograph and a few species have been transferred from other groups.

Potentilla fastigiata Nutt. was transferred from the GRACILES group. Although it connects the CONCINNAE with this group and with the CANDIDAE, and has a more erect stem than the other species, I think, after all, that it should be placed here and that it has its nearest relative in *P. concinnaeformis* Rydb. Dr. Wolf retains it in the GRACILES group and associates it with *P. tomentosa*, *P. oaxacana*, and *P. Nuttallii.* Its nearest relative outside the CONCINNAE is *P. candida* Rydb., and a few of the specimens cited by me under the latter in my monograph belong to *P. fastigiata* instead. It is evidently unknown to Professor Nelson, for under *P. gracilis*, he has the following remark: "(This may be a composite species; as here used it includes the following, which are not readily discriminated: *P. fastigiata* Nutt.; *P. pulcherrima* Lehm.; *P. Blaschkeana* Turcz. . . . .)" The leaves of *P. fastigiata* are silky-villous with rather long hairs on both sides, only very slightly tomentose beneath.

A species related to this and *P. concinnaeformis* is described in the North American Flora under the name of *Potentilla Hassei.* It differs from *P. fastigiata* in the broader, broadly obovate leaflets and the oblong instead of linear-lanceolate bractlets, and from *P. concinnaeformis* in the dense many-flowered inflorescence, the densely pubescent stem, and the oblong bractlets. Besides the type given in the North American Flora, I have seen the following specimens, referable to it:

CALIFORNIA: Head of Stanislaus River, 1903, *Hall & Chandler 4778.*

There has been no change made in *Potentilla concinnaeformis*, *P. oblanceolata*, and *P. bicrenata* since my monograph, except that the range of the last one has been extended to Wyoming, where it has been collected by Professor Nelson. Dr. Wolf admits all three as species, although he had not seen specimens of any of them. Concerning the reduction of *P. obovatifolia* Rydb. to a variety of the first one, see my remarks on page 493.

A further study of *P. concinna* and its variety *divisa* brought to light facts that seemed to me sufficient to warrant the raising of the latter to specific rank.

In the North American Flora, I transfer *Potentilla quinquefolia* Rydb. to this group. In my monograph I had placed it with *P*

subjuga. My placing it with that species was done simply because both show a tendency to combining digitate and pinnate characters in the leaves. Dr. Simmons in the Flora of Ellesmereland, has rightly criticized me for so doing. The species was based upon *Potentilla nivea pentaphylla* Lehm., as represented by some of the specimens cited in Hooker's Flora Boreali-Americana. Unfortunately Dr. Lehmann did not propose the name in the work just mentioned, although he gave a description. His publication of the variety did not appear until 1850.* In the meantime, the name had been taken up by Turczaninow,† but whether for the same plant or not I can not tell. As the name *pentaphylla* was not available I used another name, *P. quinquefolia*, and it matters little what plant Turczaninow had, as *P. quinquefolia* applies to the North American plant characterized in my description. In 1900 Mr. Morten Pedersen Porsild sent me a collection of Potentillas from Greenland. I undertook to determine them and also published a paper upon them in the Bulletin of the Torrey Botanical Club for March, 1901. Some of the work was hastily done and several corrections to that paper must be made. One of the mistakes made was that I regarded *P. nivea subquinata* Lange as identical with *P. quinquefolia.* Following the Madison amendments to the Rochester Code, I substituted the name *P. subquinata* (Lange) Rydb. for *P. quinquefolia. P. nivea*, as well as other 3-foliolate species, has occasionally some of the lower leaves 5-foliolate, but *P. quinquefolia* has them nearly always so. On account of this confusion, I have been severely criticized both by Dr. Simmons and by Dr. Wolf for regarding *P. quinquefolia* Rydb. as a distinct species. The former made the following remarks: "there being not the slightest cause to look upon it as a species as Rydberg has done, probably because he has had no opportunity of studying the plant from nature." If Dr. Simmons had taken a little trouble, he could have found that this statement was not exactly true, for in my monograph, I cited a specimen collected by myself in Montana, viz., *Rydberg & Bessey 4397*, and I had had opportunity to study it in the field. I have since collected it at two other stations, one in Colorado and one in Utah.

*Delect. Sem. Hort. Hamb. **1850**: 12. 1850.
†Bull. Soc. Nat. Mosc. **14**: 607. 1843.

In neither case did I find a single specimen that could be referred to *P. nivea*. At the Colorado station it was associated with *P. saximontana* and *P. uniflora*, but was easy to distinguish, especially from the latter. In the collections at the New York Botanical Garden there are eighteen sheets of *P. quinquefolia*, representing sixteen localities. I have seen perhaps as many more localities represented in other herbaria, and have seen no sheets on which it was mixed with *P. nivea* proper. We have only four sheets of *P. nivea* from the Rocky Mountain region. When I visited Copenhagen in 1901, I confused *P. rubricaulis* with it and named a specimen of the latter *P. subquinata*. This was due mostly to the fact that I had a wrong idea of *P. rubricaulis* Lehm. and had applied the latter name to what appears in the North American Flora as *P. rubripes* Rydb. Dr. Simmons has cleared up *P. rubricaulis* Lehm. in such a way that nothing more needs to be said, except perhaps that he could have made plainer the differences between the trifoliolate *P. rubricaulis* var. *arctica* and *P. nivea* L., taken in such a broad sense as Dr. Simmons has done. Of the specimens collected by Pedersen and referred to *P. subquinata* by me, *no. 496*, as represented in the New York Botanical Garden herbarium, is a form of *P. nivea* L., with some quinate leaves. It is intermediate between *P. nivea macrophylla* and *P. nivea subquinata*. *Nos. 113* and *233* belong to *P. nipharga* Rydb., which also sometimes has quinate leaves. The other numbers are not represented here. There is none referable to *P. quinquefolia*, which seems confined to the Rocky Mountains of the United States and Northwestern Canada.

Closely related to *P. quinquefolia*, perhaps a depauperate variety thereof, is *P. modesta* Rydb., described as new in the North American Flora. It is confined to two mountain chains in Utah. It differs from *P. quinquefolia*, besides in the smaller stature, in the linear and obtuse instead of lanceolate and acute bractlets, the golden yellow petals only 4 mm. long, and the dense inflorescence, reminding one of that of *P. Hookeriana*. The following specimens belong to it:

UTAH: Mount Barrette, July 26, 1905, *Rydberg & Carlton 7261, 7259*, and *7258;* Sierra La Sal, 1899, *C. A. Purpus G, Q*, and *R*.

NIVEAE

This group is represented in the North American Flora by nine species. Of these, two are proposed as new, *P. nipharga* and *P. Pedersenii*, the first based on specimens referred to *P. nivea* and several of its varieties, the latter based on *P. subquinata Pedersenii* Rydb.

Dr. Simmons in his Flora of Ellesmere Land remarked: "Rather might it be justifiable to distinguish all the arctic forms with deeply incised leaflets, from the typical *P. nivea*, which has them more rounded and feebler dentate. I have, however, had too little opportunity to study them from nature, to be able to give any definite opinion about it. . . . Rydberg has, however, not only established a new species *P. quinquefolia* for the plant here in question, but . . . ." If we compare this quotation with the other one from the same discussion given above we notice that Dr. Simmons contradicts himself. In the first quotation he states "there being not the slightest cause to look upon it as a species" and in the latter "rather might it be justifiable to distinguish all the arctic forms. . . ." These arctic forms with deeply incised leaflets, certainly look very different from *P. nivea* proper, but at the same time they are not the same as my *P. quinquefolia*. As I could not find any available name for them I proposed *P. nipharga* in the North American Flora. The plant is not exclusively arctic, for similar specimens, although usually smaller, have been collected in the Rockies, especially in Utah. Some of the specimens included in *P. nivea dissecta* by S. Watson belong here, others belong to *P. divisa* Rydb. The name *dissecta* is, however, not available. *Potentilla nivea subquinata* Lange is probably a form of this with some quinate leaves, but as the name *P. subquinata* has been applied to another species, it is not available for this. It includes probably *P. nivea arenosa* Lange, but it is not *P. nivea arenosa* Turcz. I think that it is *P. nivea pinnatifida* Lange (not that of Lehmann), but *pinnatifida* can not be used as a specific name for it. It is the same as *P. nivea altaica* Rydb., at least as far as the Utah specimens are concerned. I thought that it was the same as *P. altaica* Bunge, but have seen my mistake. I agree fully with the opinion of Dr. Simmons that "it [*P. altaica*] does not belong to *P. nivea*," not even if *P. quinquefolia*, *P. ni-*

pharga, and *P. uniflora* are included. Dr. Simmons states further: "In the Index Kewensis, it is referred to *P. multifida* L., where its right place seems rather to be." This statement was made after Dr. Simmons had seen the original specimens of Bunge. It is not unlikely at all that its relationship is with *P. pinnatifida*, but the plate illustrating it does not resemble so much *P. pinnatifida* as *P. Hookeriana*. The latter is also intermediate between the NIVEAE and the MULTIFIDAE groups, both in habit, the congested inflorescence, and the fusiform style. I can not agree with Dr. Wolf in regarding *P. altaica* as merely a form of *P. nivea pinnatifida* in the sense he uses the name. I refer the following specimens to *P. nipharga*:

MACKENZIE: Fort Good Hope, 1861–2, *I. S. Onion* (type).

ALBERTA: Rocky Mountains, *Drummond 368*.

UTAH: Sierra La Sal, 1899, *C. A. Purpus A, C, L*, and *H*.

GREENLAND: Vajat-shore, Disco, *Morten Pedersen 113;* Unartuarsuk, Disco, *Morten Pedersen;* Onjigsak, Disco, *Morten Pedersen 233*.

Potentilla Pedersenii Rydb. was based upon *P. subquinata Pedersenii* Rydb. In describing the latter I had only one collection in flower, viz., *Morten Pedersen 470*, and the description was drawn wholly from that. Laying too much stress upon the peculiar rootstock of this species and almost overlooking more essential characters, I referred carelessly to it several sterile specimens with a similar rootstock. These do not belong to it and Dr. Wolf is fully correct in his criticism of me for basing the variety on a mixture and for including in it specimens which he refers to *P. nivea* and var. *subquinata*. The type specimen he regards as a small-flowered *P. Wahliana*. With this I can not agree. It is true that it has something of the habit of *P. Wahliana*, the long hairs, although not yellowish, of that species, and the pubescent upper surface of the leaves; but it does not have the large, broad, and overlapping petals of *P. Wahliana*, or the oval or elliptic obtusish bractlets characteristic of that species and *P. villosa*. It has the flowers of *Potentilla nivea*. It could be a hybrid of *P. nivea* and *P. Wahliana*.

Dr. Wolf regards both *P. uniflora* and *P. Hookeriana* as vari-

eties of *P. nivea*. *P. Hookeriana*, at least, is very distinct, and were it not for the 3-foliolate leaves, I would associate it with the MULTIFIDAE group, especially with *P. pseudosericea* and *P. paucijuga*. The style is just as fusiform as in those species and the inflorescence is compact as in that group, not open as in the typical species of the NIVEAE.

Dr. Wolf also regards *P. prostrata* as a variety of *P. nivea*, in this respect following Dr. Lehmann, but neither Lehmann nor Wolf seems to have seen the type of *P. prostrata* Rottboell. Dr. Wolf refers to it a specimen collected by Morten Pedersen, labeled as *P. quinquefolia* Rydb., but according to Wolf, better referable to *P. nivea macrophylla*. It is probably *Pedersen 496* that is referred to, but this has nothing to do with *P. prostrata* Rottb. The type of the latter is in the herbarium of the Botanical Garden at Copenhagen, where I saw it in 1901 and drew from it the description which is found in the North American Flora. I have seen no other specimen resembling it, and no form of *P. nivea* or of any of the species often included in it approaches it. The leaflets resemble those of *P. gracilis* but are three in number, and the flower and inflorescence are different.

NEW YORK BOTANICAL GARDEN.

Contributions to the Mesozoic flora of the Atlantic coastal plain—VI. Georgia

Edward W. Berry

No fossil plants have been specifically recorded from the coastal plain of Georgia, although several Eocene plant localities are mentioned by McCallie in his Report on the Underground Waters of Georgia* and one of the following Cretaceous localities is mentioned by Veatch in his recent Report on the Clay Deposits of Georgia.† With the exception of this latter locality near Buena Vista in Marion County all of the following localities have been discovered recently by Dr. L. W. Stephenson or the writer.

Both Lower and Upper Cretaceous deposits are present in Georgia, the former, which have thus far proved unfossiliferous, extending entirely across the state along the "fall-line" and the latter extensively developed west of the Ocmulgee River, which is in the central part of the state, being transgressed east of that point by the late Eocene.

These Upper Cretaceous deposits have been divided by Veatch, on lithologic grounds, into five units, which are, from the oldest to the youngest, the Eutaw (=Tuscaloosa formation), Blufftown, Cusseta, Renfroes, and Providence. They emphasize slight alterations in conditions of sedimentation whereby beds predominantly of sand alternate with marl, the Blufftown and Renfroes phases representing the latter type of sediments. These lithologic phases are fairly well defined in the western part of the state but merge toward the eastward into an indivisible series of sands with local clay lenses, for the most part unfossiliferous. The geology of this area, no doubt with a revised nomenclature, will be published shortly by Dr. Stephenson, so that the foregoing very brief outline will suffice in the present connection.

Determinable fossil plants have beeen collected from the following five localities:

*Geol. Surv. Georgia, Bull. 15: 36, 336, 347. 1908.

†Geol. Surv. Georgia, Bull. 18: 88. 1909.

1. *McBride's Ford.*—This locality is in the basal part of the Tuscaloosa formation, on the left bank of Upatoi Creek, about 10 miles southeast of Columbus, in Chattahoochee County. The plants were all collected from one small clay lens and include the following species:

Andromeda cretacea Lesq?
Andromeda Wardiana Lesq.
Androvettia sp. nov.
Aralia sp. nov.
Brachyphyllum macrocarpum Newb.
Cinnamomum Heerii Lesq.?
Cinnamomum intermedium Newb.
Eucalyptus angusta Velen.
Ficus ovatifolia Berry.
Juglans arctica Heer?
Magnolia Boulayana Lesq.
Magnolia Capellinii Heer.
Manihotites sp. nov.
Menispermites sp. nov.
Paliurus sp. nov.
Salix flexuosa Newb.
Sequoia Reichenbachi (Gein.) Heer.
Tumion carolinianum Berry?
Zizyphus sp. nov.

The *Sequoia* and *Androvettia* are the most abundant forms and the horizon indicated by the general facies of the foregoing 19 species is one homotaxial with the Tuscaloosa formation of Alabama, the Black Creek formation of the Carolinas, the Magothy formation of the northern coastal plain, and the Dakota-Woodbine formations of the western Gulf and interior.

2. *Broken Arrow Bend.*—This locality is on the left bank of the Chattahoochee River about 13 miles below Columbus in Chattahoochee County, and the flora, as at the preceding locality, comes from small clay lenses near the base of the Tuscaloosa formation. The following species have been recognized:

Malapoenna horrellensis Berry?
Phragmites Prattii Berry.
Salix eutawensis Berry.
Salix flexuosa Newb.
Sequoia Reichenbachi (Gein.) Heer.

The *Sequoia* is characteristic and is the most abundant form present. The horizon indicated is the same as in the preceding case.

3. *Chimney Bluff.*—This locality is on the left bank of the Chattahoochee River about 22 miles below Columbus and still in Chattahoochee County. The plants from this locality are near

the top of the Tuscaloosa formation and include the following species:

Araucaria bladenensis Berry.	*Salix flexuosa* Newb.
Araucaria Jeffreyi Berry.	*Salix Lesquereuxii* Berry.
Ficus crassipes Heer.	*Sequoia Reichenbachi* (Gein.) Heer.
Ficus Krausiana Heer.	

The *Sequoia* is rare at this outcrop and *Araucaria bladenensis* is the most abundant form. The indicated horizon does not differ greatly from that of the preceding localities.

4. *Near Buena Vista.*—This locality is in a gully along the Buena Vista-Tazewell road, about 6 miles northeast of the former town in Marion County. The horizon is that of the so-called Cusseta sands and the following identifiable species, based on poor and scattered material, indicate a flora not appreciably different from the preceding:

Andromeda Novae-Caesareae Hollick.	*Manihotites* sp. nov. (same as at McBride's Ford).
Araucaria bladenensis Berry.	Monocotyledon, gen. et sp. nov. (common to the Black Creek and Tuscaloosa formations).
Eucalyptus angusta Velen.	
Ficus sp. nov.	

5. *Near Byron.*—This locality is in a cut of the Central of Georgia Railway about 1.5 miles northeast of Byron in Houston County. The specimens are few and poor but point to a correlation with the Cusseta sands near Buena Vista. The following have been identified, of which the *Cunninghamites* is the most abundant:

Araucaria Jeffreyi Berry.	*Dryopteris* sp. nov.
Cunninghamites elegans (Corda) Endl.	

When this Upper Cretaceous flora, which consists of but 32 determinable species, is compared with allied floras one is struck with its paucity. For example, the Tuscaloosa flora of Alabama probably contains about 200 species, the Black Creek flora of the Carolinas about 100 species and the Magothy flora considerably more than 100 species. It is evident that the Georgia flora presents but a meager picture of the contemporaneous vegetation of the Piedmont area of Georgia. Another noticeable feature is

the coriaceous nature of most of the leaves. The conifers, which are among the slowest plants to succumb to maceration, are the most abundant types, and the various andromedas, magnolias, and lanceolate leaves of *Ficus* are also very resistant. The conclusion is obvious that all of the more delicate plant remains that floated into the Cretaceous sea were destroyed, and this is corroborated by the character of the sediments, which are predominantly sandy and indicate deposition in shallow much agitated waters. Possibly the Cretaceous coast-line in this region was not broken by any re-entrants of any size, which usually offer exceptional opportunities for the formation of bars and lagoons and the resulting mud-flats, which furnish such excellent facilities for the preservation of the terrestrial vegetation supplied by the tributary rivers. We know that vegetable matter was abundant in these Cretaceous waters from the lignitic character of many of the sands and from the dark carbonaceous clays, but the bulk of it was evidently thoroughly triturated and comminuted before entombment. Possibly too, subsequent erosion of the landward margins of the sediments may account for the absence of land plants, since at McBride's Ford near the landward margin of the deposits they are so much more abundant than at any of the other localities.

These thirty-two Georgia Cretaceous species are distributed among seventeen families in fifteen orders. They include a single polypodiaceous fern and seven species of conifers, most of the latter apparently referable to the Araucarieae, although the relatively primitive Taxaceae are represented by a species of *Tumion*. There are two monocotyledons of little significance and twenty-two dicotyledons of various affinities, including four figs, three willows, three andromedas, two magnolias, and two cinnamomums.

Perhaps the most remarkable form collected is a new species of Euphorbiaceae, very similar to the modern tropical genera *Jatropha* and *Manihot*. These leaves are of immense size and are represented in the collections by the two nearly complete leaves, restorations of which are here figured, and by a number of fragments. This species, which is unlike anything previously known either in this country or abroad, may be briefly characterized as follows:—

Manihotites georgiana gen. et sp. nov.

Leaves large, 36 cm. to 48 cm. in diameter, palmately and deeply lobate, the main lobes dichotomously sublobate. Base probably peltate. Margins entire, more or less undulate. Texture coriaceous. Venation coarse, consisting of five or six stout primaries diverging at acute angles from the top of the petiole, these forking dichotomously about five or six centimeters above their base at angles of from 30° to 50°; the branches sometimes again forking dichotomously in a distance of from four to six centimeters, or simple, or with branches clearly subordinate in

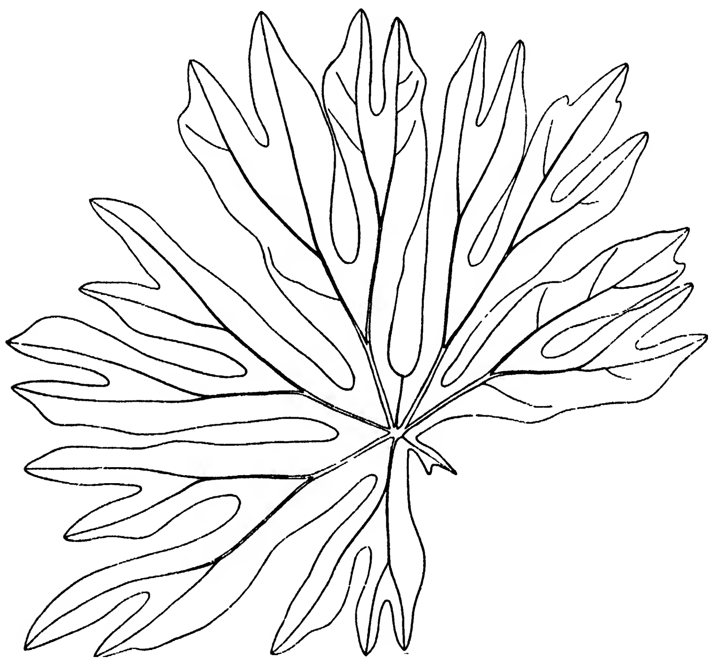

FIGURE 1. Restoration of *Manihotites georgiana* Berry, from the Upper Cretaceous of Georgia. (×¼)

size and running to the apex of a subordinate lobe. There are a sparse number of relatively fine secondaries diverging at angles of about 45° or more and apparently camptodrome. The deep and narrow but rounded sinuses approach to within three to five centimeters of the base and divide the leaf into five or more major lobes and these are subdivided by more or less deep sinuses of a similar character into inequilateral, ovate-lanceolate, obtusely pointed, subordinate lobes. [FIGURES 1 and 2.]

There was considerable variation in the lobation of these leaves as is shown by the specimens figured. It seems very probable that these two leaves were from a single plant, since it is very unlikely that two separate leaves of this size and of the same degree of preservation would have found their way out into the Cretaceous sea and have come to rest within a few inches of one another in this very small clay lens which was not over ten feet in diameter and which was several miles from the Cretaceous shore. The one leaf has the lobes broadly rounded and each main lobe divided

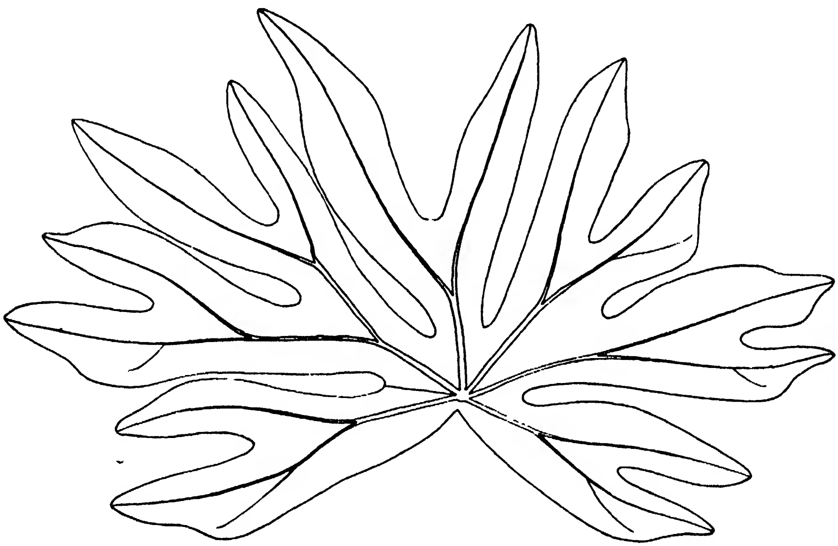

FIGURE 2. Restoration of a second nearly complete leaf of *Manihotites georgiana* Berry, from the Upper Cretaceous of Georgia. (× 1/3.33)

into two nearly equal subordinate lobes, while in the other leaf these subordinate lobes are subdivided in a like manner and some of these subdivisions are again subdivided.

The only fossils that are at all comparable to this species are, first, the forms from the Raritan formation in New Jersey described by Professor Newberry as *Fontainea grandifolia*;* second, those named *Haliserites Reichii* by Sternberg† from their supposed algal nature, although they are clearly angiospermous as Rothpletz has

*Newberry, Fl. Amboy Clays 96. *pl. 45. f. 1–4.* 1896.

†Sternberg, Fl. Vorwelt 2: 34. *pl. 24. f. 7.* 1833.

recently pointed out.* The latter fossils come from the Cenomanian of Saxony, while a third form, suggestive of the Georgia fossils from the Cenomanian of Bohemia, is called by Velenovsky *Aralia furcata.*†

The Georgia plant is, however, entirely distinct from any of these forms and it has been compared with a large amount of recent material such as *Jatropha*, *Cecropia*, various tropical *Araliaceae*, etc. It proves to be closest, however, to certain species of the genus *Manihot* of Adanson and it is believed that the remarkably variable leaves in the latter genus furnish a satisfactory clue to the relationship of this Cretaceous species, since no other comparable modern genus has leaves with similar wavy margins and inequilateral rounded lobes. This relationship is indicated in the generic name chosen for the Georgia fossils. The modern genus *Manihot* has between eighty and one hundred species in the American tropics.

An effort to picture accurately the environment of this flora is beset with unusual difficulties, as may be imagined from what has already been said. It is safe to assume that the climate was mild and humid, the latter being probably the most important factor aside from the absence of frost. That the temperature was not tropical in character we may assume from the manner in which this flora preserves its integrity when traced northward over a good many degrees of latitude. Judged by the facts of the present-day geographical distribution of plants, this flora presents an antipodean facies with its *Eucalyptus* and abundant Araucarieae, but this is only another way of emphasizing its Mesozoic character, since the abundant evidence at our command shows that both of these types were practically cosmopolitan in the Mesozoic. Another feature, strange in the eyes of modern plant geographers is the curious mingling of forms which in the existing flora are to a greater or less extent climatically segregated. Willows and walnuts growing with figs, eucalypts, laurels, and araucarias would indeed be anomalous in the present flora, but this and similar associations are familiar enough in fossil floras not only during the Mesozoic but well into the Cenozoic.

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*Rothpletz, Zeits. Deutsch. Geol. Gesells. **48**: 904. 1896.

†Velenovsky, Fl. Böhm. Kreidef. **3**: 13. *pl.* 4. *f.* 1. 1884.

Even though no close comparisons with modern ecological groups are possible it would seem that if the Upper Cretaceous flora were existing at the present time it would be included by ecological botanists under that somewhat elastic head which Schimper calls "temperate rain-forests." In no other modern plant associations do we find that commingling of temperate and tropical types that we find in certain present-day temperate rain-forests, as for example those of southern Chile, southern Japan, northern Australia, and New Zealand. In the last mentioned we find aralias, laurels, *Cinnamomum*, *Magnolia*, and *Sterculia* associated with *Quercus*, *Fagus*, *Gleichenia*, *Dryopteris*, *Dicksonia*, etc. In some respects this type in New Zealand is the most tropical in its facies and more like our eastern American Upper Cretaceous floras than any other existing flora. In New Zealand conifers are abundant and include forms with reduced leaves like *Libocedrus* and *Dacrydium*, as well as forms with broad leaves like *Dammara*, *Podocarpus*, and *Phyllocladus*. Dicotyledonae are numerous and varied, including between 100 and 150 species, among which forms of Myrtaceae, Lauraceae, Proteaceae, etc., with coriaceous leaves are prominent. The undergrowth is rich in tree-ferns and various genera of Araliaceae.

When this modern flora is compared element for element with the coastal plain Cretaceous flora many differences naturally become apparent, nevertheless the resemblance between the two is remarkable. In the coastal plain Cretaceous floras the narrow or scale-leaved conifers are represented by *Sequoia*, *Moriconia*, *Brachyphyllum*, and *Widdringtonites*. *Dammara* represents the broad-leaved araucarias, while *Androvettia* and *Protophyllocladus* represent the modern *Phyllocladus*. The dicotyledons are numerous and varied with a mixing of temperate and tropical types and with numerous coriaceous forms belonging to a number of the same families as do the New Zealand plants. Aralias are common in the former as in the latter. That the Cretaceous rainfall was plentiful may be inferred, not only from the species of plants preserved, but also from the formation of dripping points on various leaves, this feature being especially emphasized in the Tuscaloosa flora of Alabama, although it is often obscured by the facility with which these long slender tips are broken off by current action before entombment.

The present brief note is in the nature of an abstract of a full discussion of the Georgia flora which will be published by the U. S. Geological Survey, to the Director of which the writer is indebted for the permission to publish the present paper, setting forth such conclusions as seemed to be of especial botanical interest.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MD.

Additions to the flora of peninsular Florida

II. NATURALIZED SPECIES

John K. Small

The plants recorded in the following list represent species chiefly new to the hitherto known flora of the United States. Two of the species have been established on the Florida Keys for many years, and two have been collected in other parts of the United States. The others have been brought into peninsular Florida from many foreign countries and only recently established themselves as members of our naturalized flora. The specimens were for the most part secured through explorations in Florida maintained by the New York Botanical Garden.

Cyperus alternifolius L.

It was a surprise to find this African plant established in the Everglades. In company with Mr. J. J. Carter, I discovered it growing in the front prairie at a point about five miles south of Black Point Creek and two miles east of Naranja. The plant was evidently carried there through the agency of animals. Specimens were collected on January 14, 1909, *Small & Carter 2911*.

Rhoeo discolor (L'Her.) Hance

This species, commonly cultivated in Florida, has begun to establish itself beyond the limits of the gardens, and should now be recognized as a member of our wild flora.

The writer collected specimens in pinelands about Miami in November, 1904, *Small 2295*, while Mr. A. A. Eaton discovered naturally self-supporting plants at Chatham Bay, on the opposite side of the state, in the spring of 1905.

Aneilema nudiflorum R. Br.

This East Indian plant is now thoroughly established about Braidentown, Florida, and is said to be spreading rapidly. Mr. J. H. Simpson has had it under observation for several years past

and reports that it has now become a permanent member of the flora of this continent.

ZEBRINA PENDULA Sch.

A copious growth of this species was discovered in the heart of a dense hammock near the beach south of Palm Beach, Florida, in November, 1904, *Small 2168*. If the species is not indigenous it was doubtless carried to where I found it by birds or by other animals.

ANANAS ANANAS (L.) Lyons

The pineapple has become spontaneous on the mainland as well as on the Florida Keys, particularly in abandoned fields and adjacent pinelands.

SANSEVIERA GUINEENSIS Willd.

This African plant, now widely cultivated in the tropics, is naturalized in peninsular Florida, and Dr. Britton also found it growing in waste places in Key West in the spring of 1903.

MUSA SAPIENTUM L.

The common banana has established itself in low hammocks near Miami. It is abundant between Cocoanut Grove and Cutler, and thrives particularly well in Snapper Hammock. Specimens were collected there in November, 1904, *Small 2254*.

MUSA CAVENDISHII Lamb.

The dwarf banana, now widely cultivated in southern Florida, is also naturalized. It is not uncommon in waste and abandoned grounds about Miami, and I have observed it at points farther north along the east coast. Specimens were collected in Snapper Hammock between Cocoanut Grove and Cutler in November, 1904, *Small 2251*.

ALPINIA SPECIOSA (Wendl.) Schum.

Recent exploration in the Everglades has discovered this East Indian plant as a naturalized member of our flora. Mr. J. J. Carter and the writer found the plants established in hammocks between Perrine and Cutler on November 16, 1906, *no. 2469*.

ACHYRANTHES ASPERA L.

This tropical American plant was found in the Brickel Hammock near Miami on February 20, 1905, by Mr. A. A. Eaton (*no. 1188*). This collection adds a second species of the genus *Achyranthes* to our flora. *Achyranthes obtusifolia* was collected on Key West several years before.

GOMPHRENA DECUMBENS Jacq.

A native of Mexico, or perhaps of Texas and Mexico, this relative of the Bachelors Button, *Gomphrena globosa*, has been introduced into other countries chiefly through its cultivation in gardens. As early as 1897 Mr. N. K. Berg collected specimens at Tampa, and in 1903 Dr. Britton collected specimens in the same region, *no. 80*.

CLITORIA TERNATEA L.

This plant, originally from the East Indies, but now widely dispersed through the tropics, has escaped from cultivation in Florida. Specimens were collected by the writer in pinelands between Cocoanut Grove and Cutler in November, 1904, *no. 2225*.

CAJAN CAJAN (L.) Pollard

Within the last few years this species has escaped from cultivation and established itself in several localities in the vicinity of Miami. Collections were recently made as follows:

Pinelands between Cocoanut Grove and Cutler, *Small 2229*. Pinelands about Arch Creek, *Small 2305*.

DOLICHOS LABLAB L.

The hyacinth bean, grown in Florida both as an ornamental and an esculent plant, has become established as a member of our flora. Specimens were collected by the writer about Miami in November, 1904.

PHASEOLUS VULGARIS L.

The common bean has established itself in southern Florida. It occurs not only in waste grounds, but also in the pinelands remote from settlements or other human habitations. Its occur-

rence in the pinelands may be accounted for by the former existence of camps. Specimens were collected in pinelands between Cocoanut Grove and Cutler in the fall of 1903, *Small & Carter 1280.*

PHASEOLUS LUNATUS L.

The Lima bean became naturalized in Florida under the same conditions as the *Phaseolus vulgaris.* Specimens were collected on hammock islands between Homestead and Cross Key in the fall of 1906, *Small & Carter 2572.* The plant occurs under nearly similar conditions on Andros, Bahamas.

CICCA DISTICHA L.

This native of the East Indies, known as the Otaheite gooseberry, now widely cultivated in the tropics, has escaped from cultivation in South Florida, where it is grown for its fruits, which are used as a substitute for gooseberries. Specimens were collected in pinelands near Miami in November, 1904, *Small 2227.*

Breynia nivosa (W. G. Smith) Small, comb. nov.

Phyllanthus nivosus W. G. Smith

This plant, very commonly cultivated in gardens, and particularly used for hedges, in southern Florida, where it grows luxuriantly, has begun to spread beyond the limits of cultivated grounds. It makes itself perfectly at home in the pinelands and on the edges of hammocks. Specimens were collected near Miam in November, 1904, *Small 2218.* The plant is also becoming naturalized in the West Indies.

THESPESIA POPULNEA (L.) Soland.

Although introduced on the Florida Keys long ago and growing naturally there for many years, this shrub or tree apparently did not reach the mainland until recently. Specimens were collected along the shore of Biscayne Bay near Cutler in 1905, by Dr. S. H. Richmond, of Cutler. The fruits from which these trees originated were evidently floated across the bay from the Keys.

HIBISCUS SABDARIFFA L.

The roselle or Jamaica sorrel, cultivated in southern Florida for its edible flowers, has become established in pinelands and waste

places about Miami. The plant is a vigorous grower and thrives exceedingly well in that region. Specimens were collected there in November, 1904, *Small 2280.*

HIBISCUS CANNABINUS L.

The ambaree or brown Indian hemp is naturalized in both pinelands and about hammocks in southern Florida. Specimens were collected near Miami in the fall of 1903 by the writer and Mr. J. J. Carter.

HIBISCUS ROSA-SINENSIS L.

The Chinese rose or shoe-black plant, cultivated throughout peninsular Florida, chiefly for its showy flowers, is naturalized, especially in the southern portions of the peninsula. We have specimens collected on the west coast at Pinellas, by Mr. Otto Frank and on the east coast about Miami by the writer.

JASMINUM GRANDIFLORUM L.

This widely cultivated tropical plant has escaped from cultivation and is growing spontaneously in the pinelands north and south of Miami. Specimens were collected at two stations in November, 1904:

Between Cocoanut Grove and Cutler, *Small 2223.*
About Arch Creek, *Small 2307.*

ANGELONIA ANGUSTIFOLIA Benth.

This tropical American plant, commonly cultivated in gardens, has become established as a member of our wild flora in southern peninsular Florida. Specimens were collected in Dade County, in December, 1903, by Mr. A. A. Eaton, *no. 872.*

RUSSELLIA JUNCEA Zucc.

This Mexican shrub, commonly cultivated in gardens, has now become established in peninsular Florida. Professor P. H. Rolfs reports it as especially plentiful about towns on the west coast.

THUNBERGIA FRAGRANS Roxb.

Several species of *Thunbergia* are generally cultivated in Florida, but only one seems to have become naturalized. The species cited above was collected growing wild in waste places

as early as 1894, at Eustis, *Nash 728*. The writer has observed it in similar localities at several towns in the peninsula.

PAEDERIA FOETIDA L.

This vine, remarkable for the very offensive odor of its foliage when bruised, has become established about Sanford. Specimens were collected there by Mr. S. Rapp in 1903.

TRIDAX PROCUMBENS L.

This tropical American species, hitherto known as a member of our flora only from the Florida Keys, is now very plentiful and permanently established in southern peninsular Florida. Specimens have been collected as follows:

Miami, November, 1903, *Small & Carter*.

Dade County, December, 1903, *Eaton 458*.

Between Cocoanut Grove and Cutler, November, 1904, *Small 2230*.

Near Arch Creek, Dade County, November, 1904, *Small 2245*.

EMILIA SONCHIFOLIA (L.) DC.

This plant of the old world tropics is now firmly established in southern Florida, where the following collections have been made:

Dade County, *Eaton 1150*.

Palm Beach, *Small 2129*.

Between Miami and Kendall Station, *Small & Carter 2755*.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1910)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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Vol. 37 No. 11

BULLETIN

OF THE

TORREY BOTANICAL CLUB

NOVEMBER, 1910

Five new species of Viola from the South

Ezra Brainerd

(WITH PLATES 34 AND 35)

I wish to report some results of my study of our southern violets during the past four years. This has consisted of field work during March and April of these years in portions of each of the eleven states covered by Dr. Small's Flora, and in the culture in my home garden of all known species and varieties of this region. My work has been greatly furthered by the kind assistance of many collectors and students of the genus, to whom I would acknowledge my grateful indebtedness, and to some of whom I allude personally in the following report.

The five new species that I describe in the present paper have been observed for at least two seasons, as they have developed from the seed to the mature plant. The first is from Florida, and is allied to *Viola Langloisii* Greene of southern Louisiana and Texas.

Viola chalcosperma sp. nov.

Plant glabrous, heterophyllous; leaves at the beginning and at the close of the season's growth uncut, the former cordate, 2–3 cm. long, the latter truncate at the base, broadly deltoid, 4–5 cm. long; vernal leaves cordate, 3-lobed, the middle lobe ovate, acute, the lateral more or less incised; flowers small, lilac-purple, raised above the leaves on slender peduncles; lateral petals bearded, odd petal sparsely villous, all finely purple-veined; cleistogamous flowers sagittate, on ascending peduncles; capsule gray, tinged with purple at base, ellipsoidal, about 11 mm. long, 5 mm. thick; persistent sepals purplish, lanceolate, 5 mm. long; auricles 3–4

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mm. long, the three outer with one or more sharp teeth; seeds the color of old bronze, 1.5 mm. long, about 50 in a capsule.—In wet soil in a wooded ravine, Jacksonville, Florida; the only known station.

This plant was first called to my attention by Miss A. M. Ryon, of New London, Conn., who sent living specimens in the summer of 1907, collected the preceding March at Jacksonville, Fla., by Mrs. E. K. Comstock. Numerous plants were raised from seed the following season and seemed to represent an unrecognized species. On a trip to Florida in March 1909, guided by Mrs. Comstock's precise directions, I readily found her station. The plants were abundant, and collections were made on March 21 and on April 9, which will soon be distributed.

The four following belong to the group represented by *Viola palmata* and *V. papilionacea*, and marked by ovoid cleistogamous flowers on prostrate, usually short, peduncles.

Viola floridana sp. nov.

Leaves at time of petaliferous flowering on spreading petioles, cordate, acute, finely crenate-serrate, often somewhat puberulent above, 2–3 cm. wide, 3–4 cm. long, leaves twice as long and wide appearing soon after, on long erect petioles, glabrate, sometimes persisting through the winter; corolla whitish or pale violet, on peduncles much surpassing the leaves, the odd petal glabrous; apetalous flowers under soil or dead leaves, narrowly ovoid-acuminate; their ripe capsules blotched with purple, trigonous-cylindric, about 16 mm. long, 7 mm. thick, on decumbent peduncles; sepals broadly lanceolate, about one third the length of capsule; seeds 2 mm. long, salmon-colored or dark brown, about 60 in a capsule.—Moist rich woodland, northern and central Florida.

This I first collected March 13, 1907, near Jacksonville, Fla., on an embankment for a street railway across a little marsh near Woodlawn Cemetery. Plants sent home at that time, or their offspring, have since been growing in the Middlebury garden. In March and April, 1909, I found the plant in several other stations near Jacksonville, and at stations widely separated in Volusia County—near the famous DeLeon Spring, on the shores of Lake Beresford, in an orange grove on a shell island near the outlet of this lake, on the edge of a tilled field near Lake Munroe, and in moist woodland near Deep Creek. In flower and fruit it

resembles *V. esculenta*, but its constantly uncut leaves on erect petioles and its habitat in well drained soil seem to mark it as distinct. *V. esculenta* was not found in Volusia County.

Viola rosacea sp. nov.

Acaulescent; leaves at vernal flowering narrowly ovate-cordate, acute or acuminate, crenate-serrate, 2–4 cm. long, sparsely hirtellous above; later leaves broadly ovate, subcordate, acuminate, glabrous, 5–7 cm. long; corolla rose-purple, about 2 cm. broad, spurred petal glabrous or slightly villous; cleistogamous flowers ovoid, on prostrate peduncles; their mature capsules ellipsoid, about 12 mm. long, 6 mm. thick, purple-dotted, enclosed for half their length in lanceolate sepals; the auricles of the three outer sepals short, appressed, entire, rounded; seeds buff, 2 mm. long, about 50 in a capsule.—Dry open woodland, Point St. Martin, near Biloxi, Mississippi; well drained borders of bayous, Crowley, Louisiana.

I first observed this species March 19, 1908, in a grove of deciduous trees on the fair-ground at Crowley, La. On the low, often flooded, borders of the neighboring bayou, *V. Langloisii* grew in profusion; but *V. rosacea* was confined to stretches of woodland above the flood-plain. I afterward collected it in similar situations in adjacent townships. The plant even at that early date was out of flower, with leaves and capsules nearly mature. Moreover, live plants shipped to Vermont failed to furnish flowers the following spring. Last March on my way South Dr. Small showed me a puzzling specimen of *Viola* collected by Professor S. M. Tracy at "Point St. Martin," Miss., March 10, 1898, *no. 5008*. A few days later I had the great pleasure of enjoying Professor Tracy's hospitality at his beautiful home on the north shore of the Bay of Biloxi, and of learning that the station for his *5008* was on his own premises, that in fact the violet was then in flower on the grounds in front of his house. In the early morning we examined the plant. The flowers were beautifully rose-colored, a feature quite unusual in the genus. A mist of dew on the foliage brought out strikingly the minute stiff pubescence of the upper surface of the leaves. This and the Crowley plant proved to be identical. A half dozen vigorous specimens from each locality have the past summer been growing side by side in the Vermont garden.

Viola Lovelliana sp. nov.

Plant often minutely hoary-pubescent on the upper part of the petiole and the adjacent lower surface of the blade, the pubescence elsewhere sparse and obscure; leaves cordate at base, earliest often uncut, later ones hastately 3-lobed, the middle lobe much the longest, lanceolate, sometimes contracted at the base and undulately serrate, the lateral lobes divaricate, either lunate or variously 2–3-cleft; leaves at petaliferous flowering 2–5 cm. long, those of late summer twice as long, often less deeply cut, or uncut; flowers violet-purple, on petioles often taller than the leaves, the three lower petals villous at the throat and marked with dark purple lines; cleistogamous flowers and immature fruit on prostrate peduncles; ripe capsules purple-dotted, trigonous-ellipsoid, about 14 mm. long, 7 mm. thick; sepals broadly lanceolate, acute, one third the length of capsule; auricles short, appressed, rounded, sparsely ciliate; seeds buff, 2 mm. long.—Sparsely wooded hillsides and knolls; from southern Louisiana to eastern Oklahoma.

Live plants of this, as an unknown species, were sent me in March, 1906, by Mrs. Phoebe Lovell, of Crowley, La. The plants did well in the garden; and mature leaves and fruit from cleistogamous flowers were obtained the following August, and petaliferous flowers in the spring of 1907. On my southern journey in March, 1908, I visited the station, a recent pine-chopping on loamy clay, more or less broken by low ravines. Four additional live plants were shipped home, and from each of these, and from their seedlings in 1909, many specimens were made of the mature plant.

The species turns out to be a common one in the western portion of the territory covered by Dr. Small's Flora. In April, 1908, I collected it in open woodlands near Muskogee, Okla., a mile from the Arkansas River; also, in the same state, under dwarf oaks on the slopes of a rocky hill at Eufaula, and in the vicinity of Stigler. In March, 1910, I obtained beautiful specimens at Mansfield, La., in a piece of woodland cut up by deep ravines; and also at Mena, Ark. I have in addition to these specimens one from Texarkana, Ark., "Pine woods, April 6, 1905, *B. F. Bush, no. 2237.*"

Viola Egglestonii sp. nov.

Plant acaulescent, of spreading habit, especially when young; leaves truncate at base, often flabellately decurrent, rarely subcordate; early leaves simply 3–5 lobed, later ones 3-parted, with

the middle or all three primary segments 2–3-cleft, the divisions oblanceolate or linear, crenately serrate toward the summit and bearing a few long narrow teeth below, the central division much the widest; flowers violet-purple, lateral petals bearded at the throat, spurred petal somewhat villous; cleistogamous flowers and fruit on short underground peduncles till seeds ripen; capsules green, turning gray, broadly ellipsoid, about 8 mm. wide and 13 mm. long, with lanceolate sepals one third as long; their auricles short, appressed, the three outer dentate; seeds brown, 2.5 mm. long. (PLATES 34 and 35)—Limestone barrens, West Nashville, Tennessee, *W. W. Eggleston, no. 4421*, May 26, 1909, type. Flowers and mature fruit and leaves observed from plants transferred to garden at Middlebury, Vermont.

This species is so distinct that at first sight of the growing plant one might not suspect to what known violets it was nearest of kin. It is a vigorous plant under cultivation. In the early stages of its growth the leaves spread out horizontally in all directions, and the roots penetrate deeply into the soil. In midsummer, when cespitose, the leaves are most of them erect and long-petioled. I know of no violet whose cleistogamous flowers and fruit are more thoroughly concealed under the soil; and as a result the capsules are rarely eaten into by beetles, often troublesome pests when one is endeavoring to collect violet seeds. Only a day or two before its seeds ripen does this unique species extrude its round green capsule from the ground, and lift it erect from its nodding position on the peduncle. Then after an hour or two of fair weather the three broad valves open widely, disclosing its large brown seeds; and in another hour, by the contraction of the thin sides of the valves, the seeds are pinched out and flirted in all directions.

This violet has as yet been found at one station only. But it may be expected to appear, to the collector who is looking for it, in many other of the extensive limestone barrens of Tennessee, and of northern Alabama and Georgia.

The types of the five species described in the present paper will be deposited in the herbarium of the New York Botanical Garden.

MIDDLEBURY, VERMONT.

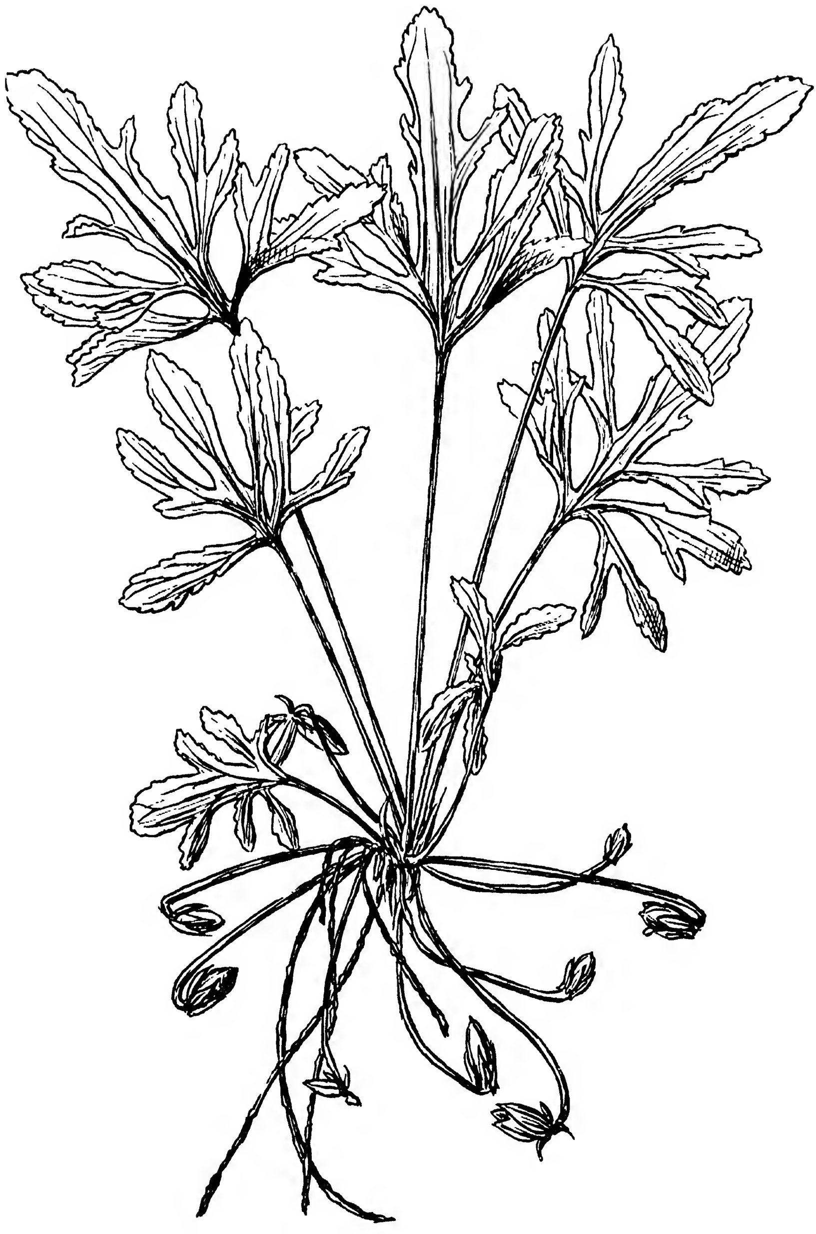
Explanation of plates 34 and 35

PLATE 34

Viola Egglestonii Brainerd, natural size. Specimen collected at West Nashville, Tennessee, by W. W. Eggleston, May 26, 1909, *no. 4421*—type.

PLATE 35

Viola Egglestonii Brainerd. From three plants grown in the garden of E. Brainerd, Middlebury, Vt., transplanted from West Nashville, Tenn., May, 1909. A. Flowering specimen, May 10, 1910; $\times\frac{2}{3}$. B. A full-grown summer leaf, July 14, 1910; $\times\frac{2}{3}$. C. A mature capsule from cleistogamous flower, Oct. 1910; $\times\frac{4}{3}$.



VIOLA EGGLESTONII BRAINERD

VIOLA EGGLESTONII BRAINERD

Pollination experiments with Anonas

P. J. Wester

Among the tropical and semi-tropical fruits that have found a congenial home in south Florida are the sugar apple, *Anona squamosa* L., the custard apple, *Anona reticulata* L., and the cherimoya, *Anona Cherimolia* Miller; one species, the pond apple, *Anona glabra* L., is indigenous. The sugar apple was introduced in 1833 by Dr. Henry Perrine, but whether the plants survived after his death in the massacre at Indian Key in 1840, and are the progenitors of the now naturalized plants of this species on the Florida Keys, or whether some of these are the offspring of a later unauthenticated introduction will probably never be known. It is probable that several separate introductions have been made from the Bahamas, where the species luxuriates and with which islands the early settlers on the Florida Keys were in intercommunication. Introductions have probably also been made from Cuba by way of Key West. The custard apple was probably introduced in a similar manner. The cherimoya referred to by Reasoner in Bull. No. 1, Div. of Pomology, U. S. Department of Agriculture, in 1887, is the custard apple, with which the cherimoya is very frequently confounded. The first authentic introduction of the cherimoya was made in 1895, when Mr. William Freeman brought seed to Little River from San José, Costa Rica.

The two first-named species have fruited fairly well in Florida, the sugar apple frequently coming into bearing the third year from the sowing of the seed; but only rarely do the trees bear abundantly. The failure of the cherimoya to set fruit after having bloomed for several years led the writer to begin investigations in 1907, in regard to the probable cause of the sterility of this species in Florida. From the construction of the flowers and their fragrance it became evident that they were entomophilous, and in the course of the observations it was discovered that they were proterogynous. After this discovery was made there was begun a comparative

study of the flowers and pollination of the sugar apple and the custard apple, the flowers of which superficially appeared to be identical with those of the cherimoya. It was then found that these two species were likewise proterogynous. In the course of this investigation it was noted that the flowers of the cherimoya and the custard apple shed their pollen in the afternoon from about 3.30 to 6 P.M. In the sugar apple the pollen is discharged in the morning from the rising of the sun to about 9 A.M., when practically all the pollen is shed. After examinations of a large number of trees of this species three were found to shed their pollen in the afternoon and the interesting fact was noted that this phenomenon does not occur on the same trees in the morning. A more limited number of trees of the custard apple and the cherimoya were available for observation; were it extended to a large number it is quite probable that individual trees may be found that shed their pollen at other times of the day than has been noted in the course of these observations.

The flowers of the three species enumerated, belonging to the section *Attae* Martius, are nodding; the calyx is tripartite, the sepals small and triangular; the six petals are arranged in two rows, the three exterior ones being linear-oblong with an obtuse sometimes acute apex; outside, these petals are ferruginous-tomentose and velvety in the cherimoya, while in the custard apple and the sugar apple they are greenish and sparsely hairy. The petals are shortest in the custard apple, being sometimes only 16 mm. long; in the cherimoya they frequently exceed 30 mm. in length. In all species they are keeled inside, whitish, concave, with a maroon blotch in the cavity, at the base; the interior petals are rudimentary; the number of stamens, which are attached to the torus, is indefinite and they cohere by a connective gland beyond the anthers, surrounding the syncarpium in which an indefinite number of carpids are united. As the flowers become full grown a viscid fluid is secreted that covers the syncarpium and which appears to be most abundant about twenty-four hours before the pollen is shed.

Until the shedding of the pollen the petals assume an almost perpendicular position (see FIGURES 1 and 3*a*) and leave a small opening, facing downward, for the entrance of pollen-bearing

insects.* (In individual trees of the cherimoya the apical end of of the petal is curved outward, though not to the extent of facilitating the conveyance of pollen to the stigma.) As the time approaches for the discharge of the pollen, the petals spread out and upward so rapidly that the movement is readily perceived; this phenomenon is accompanied by the exhalation from the flower of a fragrance analogous to that of a well-ripened banana

FIGURE 1. Flower of the cherimoya, showing position of petals when the stigmas are in the receptive state. (One third natural size.)

or pineapple in the cherimoya and custard apple; in the sugar apple it partakes of the odor of ethyl acetate and continues for a few hours until the pollen is shed, after which it disappears and the petals wither. The fragrance is also noticeable in the flowers twenty-four hours previous to the shedding of the pollen and is undoubtedly intended to serve as a guide for insects that aid in the pollination. The stigma is now readily approached by large as well as small insects and were the stamens and stigmas synchronous self-pollination by insects or the wind might be effected (FIGURES 2 and 3*b*).

*This expression is used advisedly, as it is very evident that the flowers are not constructed for wind pollination nor are self-pollinized, as will appear presently.

Owing to the advanced season of the year when the investigation began, with the consequent scarcity of bloom, extensive observations must perforce be suspended until the advent of the flowering season of another year. A small beetle, identified by Dr. C. L. Marlatt, assistant chief of the Bureau of Entomology as *Colastus truncatus*, was then found acting as pollinating agent in considerable numbers in the flowers of the sugar apple. This spring (1910) I found the same insect in flowers of the cherimoya and sent a specimen of this as well as of another species to the Bureau of Entomology for identification. The latter was identified by Prof. F. H. Chittenden as "*Triphleps*, probably *insidiosus*."

FIGURE 2. The same flower as in Figure 1, 24 hours later, showing position of petals when the pollen is discharged. (One third natural size.)

As this specimen is the only one of this species so far discovered, its presence in the flower may have been accidental. Another small beetle was found in the flowers of the sugar apple and sent to Dr. Marlatt for identification in 1908, who transmitted to me the following notes, by Mr. E. A. Schwarz, in regard to this species:

"The small brownish beetle has for a number of years been represented in our collection, but belongs to a family of Coleoptera which has been very little studied so far, the genus of which has never been determined. As near as we can say it belongs to the group *Pharaxonothi*. Many years ago the species was found by

the late Mr.H. G. Hubbard, an assistant of the Bureau, and he made some interesting observations on it at Crescent City, Florida. The larvae were found by him feeding upon the substance of the flower stems of both male and female cones of the coontie plant, *Zamia integrifolia*, but in no way injuring the flower. Mr. Hubbard came to the conclusion that both the larvae and the imagos of this little beetle are intended to facilitate the fertilization of the plant. The same species was found by me in great numbers on the flowers of the Florida palmetto and no further notes have been taken by me. The species does not seem to occur in the West Indies, nor is anything similar reported from Central America. There are various genera of the family described from South America but whether or not this species is identical with any one of them can not be ascertained at present."

FIGURE 3. Flowers of the sugar apple; *a*, when the stigmas are receptive to the pollen; *b*, at the time of the discharge of the pollen. (One third natural size.)

In addition to these species a small thrips frequents the flowers of these Anonas and probably to some extent assists in their pollination.

In order to ascertain the validity of the theory of proterogyny in the Anonas in question a series of pollination experiments was inaugurated in 1908 on all three species, which was concluded this spring. In the course of this experiment on a cherimoya tree pollen was applied to the stigmas of twenty-seven flowers at the time of the discharge of the pollen in the flower, all of which dropped. The pollen was in some instances taken from the flower

pollinated, in others from other flowers of the same tree. In a few instances pollen of the sugar apple and the pond apple was applied. Thirty-four flowers were pollinated twenty-four or more hours before the shedding of the pollen and all set. Many of these dropped after partial development but the dissection of the

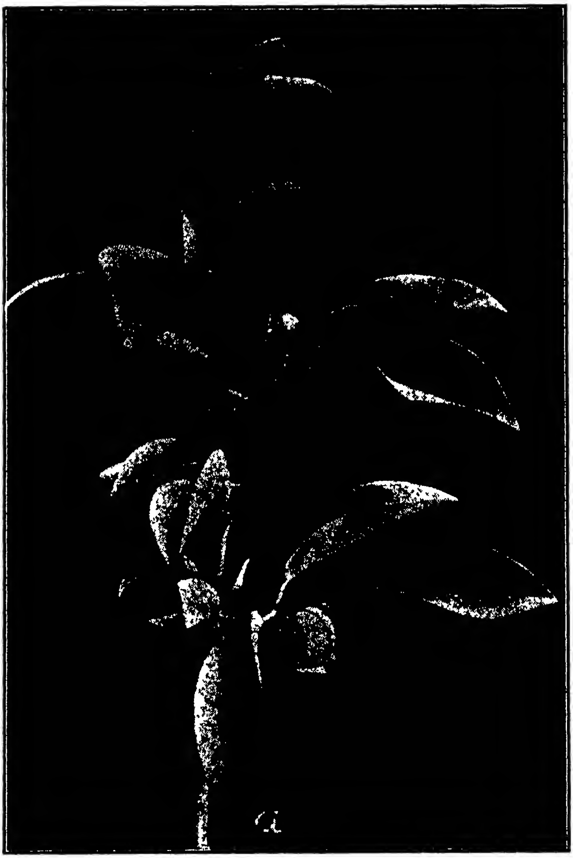


FIGURE 4. Pond apple flowers; a type introduced from Trinidad, B. W. I. (One third natural size.)

immature fruits showed that fertilization had taken place and that the drop was due to some other cause. In many instances it was undoubtedly due to overproduction, as the tree was too small to bring to full maturity all the fruits that set. Pollination of the flowers on the same tree in 1909, according to the theory of pro-

terogyny, produced another crop of fruits that year and the flowers responded likewise to pollination in the spring of 1910. Dr. A. Robertson Proschowsky, Nice, France, writes me that the results obtained by him in pollination experiments conducted on the cherimoya are analogous to those obtained by the author.

The plants of the sugar apple and the custard apple available for experimentation bore a larger number of flowers than the one cherimoya plant, and 143 flowers on one sugar apple tree were, in

FIGURE 5. Pond apple flowers; a type indigenous to South Florida. (One third natural size.)

April and May, 1908, pollinated with their own pollen or that of flowers of other plants of the same species, 41 with pollen of the cherimoya, 41 with pollen of the pond apple, and 51 flowers with pollen from the custard apple. In no instance did fruit set where the pollen was applied to the stigma simultaneously with the discharge of its pollen; practically all responded where it was applied fifteen to forty-eight hours previous

to this act, though here, as in the case of the cherimoya, the tree shed much of the fruit before it matured owing to its inability to carry it all. In September twenty-five pollinations of flowers on a sugar apple tree were made, in accordance with the theory of proterogyny, all successful. In order to verify the observations already made in regard to the pollinization and fertilization of the flowers of the species, over 100 flowers were pollinated on three trees in April and May, 1910, the results confirming the conclusions already made.

The pollination experiments with the custard apple in 1908 were conducted on three trees. In the course of these experiments 154 flowers, pollinated twenty-four hours before the discharge of the pollen in the flower, all, with few exceptions, set; 104 flowers, pollinated at the time of its discharge, all dropped.

The writer has in the course of his work with the Anonas in a very few instances noted that individual trees subjected to apparently the same conditions as others less fruitful were exceedingly prolific and from the results obtained in these investigations concluded that this was possibly due to synacmy and self-pollination. In order to obtain some information on this point with respect to the pond apple and to ascertain whether the pollination of the flowers of this species conformed to the same laws as those of its cultivated congeners, a series of experiments was carried through during April and May this year. Sixty-two flowers were bagged, in order to exclude all foreign pollen; none of these set. Fifty-six flowers were pollinated with pond apple pollen eighteen or more hours before the discharge of the pollen, and seven with pollen of the sugar apple and the cherimoya, with the result that sixty flowers were fecundated. The pollination of the flowers of this species thus appears to be analogous to that of its cultivated congeners.

The flowers of the pond apple, which belongs to the section *Guanabani* Martius, have six distinct, glabrous, concave, fleshy, outwardly yellowish white petals, in two series, the exterior being 25 to 40 mm. long, marked with red near the base inside, the interior smaller and red within except for a narrow transverse yellowish band near the base, the arrangements of the androecium and gynoecium being similar to those in the *Attae*. The flowers

open sufficiently twenty-four hours before the shedding of the pollen to admit the entrance of small insects to the stigmas. Practically all the flowers shed their pollen early in the morning before sunrise; only rarely has it been noted in the afternoon. This is accompanied by a strong, rather disagreeable odor and it is highly probable that the pollination is performed by nocturnal insects. There is no evidence that the pollination of this species is performed in the manner indicated by Morong in *Anona cornifolia* St. Hil., the construction of whose flowers is very similar, and the results obtained in the pollination work show that the pollen must be conveyed from one flower to another in a less advanced stage of development.

In this connection it is interesting to note that the observations on *Anona cornifolia* St. Hil. in Paraguay by Morong, to which my attention was directed a few months ago, led him to the conclusion that this species also is entomophilous.

"The stigmas lie . . . as far as I could judge entirely out of reach of the pollen by any action of the organs themselves. I found, however, that the pollen was very plentiful and that a pin thrust through the anthers obliquely would carry its grains to the stigmas. There seemed in the older flowers to be evidence that this operation is performed by insects, and I came to the conclusion that the plant must always depend for fructification upon insect agency."*

It would appear that Morong considered the stamens and pistils synchronous, although it is not evident that this conclusion was arrived at after investigation. That the flowers might have been dichogamous seemingly escaped him.

In the course of the pollination experiments of the cherimoya and custard apple a very interesting observation of the retardation of the development of a large number of fruits was made. Some cherimoya fruits developed without interruption from the time of pollination and matured in September, while a number remained stationary in size, about 8 mm. in diameter, until after July 25, when they suddenly began to increase in size and matured in October and November.

The flowering season of the custard apple begins in the latter

*Morong, T. Ann. N. Y. Acad. Sci. 7: 47. 1892.

half of May and continues throughout the summer and fall. Curiously enough, the flowers, which occur in great abundance, do not set until October and November, the fruit maturing in the spring. The pollination experiments with this species were started in May and continued during the following months. As already stated on a previous page, nearly all the pollinated flowers set, but with exceedingly few exceptions remained stationary in size, 6–8 mm. in diameter, until November, when they started to develop and matured in the usual season. The few fruits whose development began immediately after the pollination of the flowers matured in December.

The investigations indicate that the flowers of the cherimoya, the sugar apple, the custard apple, and the pond apple are proterogynous and entomophilous, though the pollinating agent of the last-named species has not been detected.

Since the investigations here related began, the cherimoya, after the trees have grown larger, has without artificial pollination, though sparingly, set fruit in Florida less than 20 feet above tide water. In California and Southern France it likewise fruits at a low altitude. In some parts of the world, *i. e.*, Hawaii, the species fruits only at an elevation of many hundred feet above the sea level. On investigation it may be found that this is due to the presence there of certain insects that do not occur at lower altitudes.

The sterility of the cherimoya in Florida has undoubtedly been due to the scarcity of blooms, which on this species is only one third of the number on the sugar apple, and to an insufficient number of insects to assist in the pollination of the flowers. As the trees grow larger and carry a greater number of flowers they may be expected to fruit more abundantly.

It has been demonstrated that the sugar apple hybridizes readily with the cherimoya, custard apple, and pond apple; the cherimoya has also been successfully crossed with the pond apple. So far, the attempts to cross the soursop, *Anona muricata* L., with the cherimoya, sugar apple, and custard apple have failed.

The extraordinary productivity of a few individual trees suggests a change in regard to the pollination of the flowers of these trees, possibly due to synacmy and self-pollination. Should

this hypothesis be confirmed on investigation, such trees would be of inestimable value for breeding work in the creation of varieties that are independent of outside agencies for fructification.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Studies on the Rocky Mountain flora — XXIV

PER AXEL RYDBERG

Saussurea densa (Hook.) Rydb. sp. nov.

Saussurea alpina densa Hook. Fl. Bor.-Am. **1**: 303. 1833.
Saussurea alpina Ledebouri A. Gray, Syn. Fl. **1**^{2}: 397. 1884. Not *S. Ledebouri* Herder, 1810.

Saussurea Ledebouri Herder was based on *S. subsinuata*, *S. nuda*, and *S. Tilesii* of Ledebour, which Herder united into one species under another name. All three are illustrated in Ledebour's Icones Fl. Ross., and it is evident that *S. alpina densa* Hook. is different from each of them. None of the three illustrations shows the elongated, acuminate outer bracts, characteristic of *S. densa*. Only *S. nuda* shows a dense inflorescence with subsessile heads and a low stem, but the heads are fewer and less crowded, the stem is naked above, and the leaves entire.

S. densa is a plant of the higher mountains of the Canadian Rockies.

Saussurea remotiflora (Hook.) Rydb. sp. nov.

Saussurea alpina remotiflora Hook. Fl. Bor.-Am. **1**: 303. 1833.
Saussurea alpina A. Gray, Syn. Fl. **1**^{2}: 396, in part. 1884.
Saussurea nuda Britt. & Rydb. Bull. N. Y. Bot. Gard. **2**: 187. 1901. Not. *S. nuda* Ledeb. 1829.

This species is nearer to *Saussurea subsinuata* Ledeb. than to either *S. alpina* or *S. nuda*, but the inflorescence is laxer and the involucre is different, judging from Ledebour's illustration. *S. remotiflora* grows on low ground from northern Saskatchewan to Yukon and Alaska.

CARDUUS

So many species of thistles have lately been described from the Rocky Mountains that the number has more than doubled since the issue of Gray's Synoptical Flora. Some of these species should be reduced to synonymy and some of them are probably hybrids, but I think that the larger number will remain as good

species. It seems as if it should be unnecessary to propose more, but it has been impossible for me to include the following four in any known species.

Carduus polyphyllus sp. nov.

Carduus scopulorum Rydb. Mem. N. Y. Bot. Gard. **1**: 449. 1900. Not *C. scopulorum* Greene. 1892.

Perennial; stem stout, 3–8 dm. high, very leafy, angled, arachnoid-hairy; leaves 1–2 dm. long, linear in outline, deeply pinnatifid, with lanceolate divisions ending in yellow spreading spines, green on both sides, sparingly arachnoid-hairy; heads hemispheric, about 3 cm. high and broad, usually numerous, sessile in the axils of the leaves, often forming a leafy spike 2–3 dm. long; bracts linear-subulate, densely arachnoid-hairy, the outer with rather long yellow spines often 1 cm. long, the inner attenuate into slender straight tips; corollas straw-colored; pappus plumose with slender, barbellate tips.

In my Flora of Montana, I referred this species to *Carduus scopulorum* Greene. The latter was based on *Cnicus eriocephalus* or *Cirsium eriocephalum* A. Gray, the type of which was collected by Parry in Colorado. The rather common Colorado plant is characterized by its leaves, which are grayish-tomentose beneath, and by its heads conglomerate at the end of the stem, forming a cluster which at first is nodding. *Carduus polyphyllus* is more closely related to *C. Kelseyi* and *C. Tweedyi*. From the latter it differs in the straw-colored instead of red corollas, the narrower bracts, and more numerous leaf-lobes, and from the former in the deeply dissected and decidedly crisp leaves. If the leaves are lobed at all in *C. Kelseyi* the spines are directed forward and the blades are almost perfectly flat.

MONTANA: Mountains near Indian Creek, July 21, 1897, *Rydberg & Bessey 5216* (type, in herb. N. Y. Bot. Gard.); Park Co., Aug., 1887, *Tweedy 349*.

Carduus Butleri sp. nov.

Perennial or biennial; stem angled, striate, purple, sparingly arachnoid-hairy, very leafy, 6–10 dm. high or more; leaves linear-oblanceolate or linear, almost entire or sinuately lobed, spinulose-ciliate and if lobed the short lobes ending in slightly stronger spines, green and sparingly arachnoid above, grayish-tomentose

beneath; heads few, ending the stem and short branches, subtended by narrowly linear spinulose-ciliate leaves, hemispheric, about 4 cm. high, 4–5 cm. wide; outer bracts lanceolate, brownish, glabrous or nearly so, ending in short weak spines 2–3 mm. long, the innermost linear-lanceolate, attenuate, ending in slender brownish or purplish somewhat twisted and spreading lance-linear tips, these neither dilated nor erose; corollas pinkish; pappus plumose; tips more or less clavate.

This species resembles *Carduus Kelseyi* and *C. foliosus* in the leaves, but differs from both in the scattered few heads and purplish stem. In both species mentioned, the heads are conglomerate at the end of the stem. In *Carduus Kelseyi* the involucral bracts are much narrower and decidedly arachnoid. In *C. foliosus* the bracts are somewhat broader than in *C. Butleri*, the inner ones have dilated, lanceolate and erose tips, and the leaves are usually more lobed.

MONTANA: Big Fork, July 28, 1908, *B. T. Butler*, *674* (type, in herb. N. Y. Bot. Gard.); also near Rost Lake, *677*.

Carduus lacerus sp. nov.

Probably biennial; stem stout, 6–10 dm. high, sparingly arachnoid, angled and striate; lower leaves oblanceolate, 2–3 dm. long, pinnatifid, with rather broad, ovate or lanceolate divisions ending in weak spines, glabrous or slightly long-hairy and green above, grayish tomentose beneath; upper leaves lanceolate, sessile and clasping, with somewhat narrower lobes and rather stout spines; heads more or less clustered, about 4 cm. high and broad; outer bracts ovate-lanceolate, glabrous, without glutinous ridge, ending in short stout spreading spines 3–5 mm. long; inner bracts with dilated, ovate, abruptly acuminate, erose and crisp, spreading tips; corollas rose-colored; pappus plumose; tips slightly clavate.

This species was probably included in *Cnicus scariosus* by Gray, judging from his description in the Synoptical Flora; but it is not *Cirsium scariosum* Nutt., for Nuttall characterized the latter as having arachnoid-hairy involucres, the bracts with dilated erose tips, and the leaves tomentose beneath. I know of only one species which agrees with this characterization. This is well represented by *Flodman 880*, which was distributed as *Carduus Hookerianus*.

UTAH: Wahsatch County, near Midway, July 6, 1905, *Carlton*

& *Garrett 6732* (type, in herb. N. Y. Bot. Gard.); apparently also, Salt Lake City, August, 1880, *M. E. Jones 1905*, and the same locality, Sept., 1905, *A. O. Garrett 1718*.

Carduus olivescens sp. nov.

Perennial; stem slender, somewhat tinged with purple, more or less floccose, 4–8 dm. high, leafy; leaves linear in outline, 1–2 dm. long, densely white-tomentose beneath, loosely floccose above, deeply pinnatifid, with numerous lanceolate, often 2- or 3-cleft lobes, ending in short yellow spines; heads few, peduncled, about 3 cm. high, 3–3.5 cm. wide; bracts slightly floccose on the margins, light olive-colored, darker towards the apex, ending in yellow spines 2–4 mm. long, or the innermost with lance-linear, slightly twisted yellowish tips; corollas straw-colored; pappus plumose; tips slightly clavate.

This species was first determined questionably as *Carduus Tracyi*, to which it is not closely related, not having the conspicuous broad glutinous dorsal ridges or the broad bracts of that species. In leaf-form it resembles somewhat *C. pulcherrimus*, although the upper surface is more floccose, but otherwise it is not close to that species.

UTAH: Aquarius Plateau, August 5, 1905, *Rydberg & Carlton 7450* (type, in herb. N. Y. Bot. Gard.).

Thistle hybrids are very common in Europe and even tertiary hybrids have been reported. No attempt has been made in this country to segregate or recognize hybrids in this genus. As a rule specimens of thistles are not so common in herbaria as would be expected, probably owing to the difficulty in collecting and preparing them.

Thistles are not uncommon in the Rocky Mountains, especially in Colorado. No person has perhaps contributed more to the knowledge of these plants of that state than Mr. George E. Osterhout, of New Windsor, Colorado. He has described a few species himself and others have been described from material collected by him. There are still more forms recognized by him and distributed under manuscript names, but which he has been reluctant to describe. With the aid of the material sent me by him, augmented by other specimens collected by Baker, Shear, Clements, myself, and others, it has been possible to recognize

a good many forms which I regard as hybrids. The two species which seem to have produced the most hybrids are *Carduus americanus* (A. Gray) Greene (not Rydb.) and *C. griseus* Rydb. The former of these is comparatively common in Colorado, but the latter is rather rare. Several of the specimens cited under the latter in my Flora of Colorado do not belong to it, but are hybrids of *Carduus americanus* and various species. The original of *C. griseus* and later specimens collected by Osterhout do not have the bracts dilated at all or erose; the spines of the involucral bracts are long and somewhat flattened, and the leaves are darker and less deeply divided than in *C. americanus*. The following probable hybrids have been recognized, but, like Mr. E. P. Bicknell, in the matter of *Rubus* hybrids,* we wish "to divest the subject from all nomenclatorial claims" and "to be understood merely as pointing out the probability of the occurrence of the hybrids mentioned."

CARDUUS AMERICANUS×GRISEUS

This has the leaves of *C. griseus*, *i. e.* dark green above, grayish-tomentose beneath and with short lobes, as well as the strong and broad spines of the involucral bracts of that species, and some of the outer bracts are spinulose-ciliate; but most of the bracts are erose on the margins and the inner ones have dilated tips as in *C. americanus*. The following specimens are to be referred here:

COLORADO: Toland, Gilpin Co., July 20, 1906, *Osterhout 3266;* Ward, Boulder Co., July 17, 1901, *Osterhout 2429*.

The former of these was labeled by Osterhout *Carduus erosus* Rydb. (?). The original *C. erosus* is quite different. To strengthen the probability of hybridity, it may be mentioned that Mr. Osterhout has sent in specimens of one of the supposed parents, viz., *C. griseus*, also from Toland, Gilpin Co., collected on the same date, his *3267*, the next number, and that *C. americanus* is a rather common plant in Colorado.

The latter of the two specimens was determined by me as *C. griseus*, although I now regard it as a hybrid of that species and *C. americanus*. *C. americanus* has been collected at Ward, by Tweedy.

* Bull. Torrey Club **37**: 399. 1910.

CARDUUS AMERICANUS × SPATHULATUS

This resembles most *C. americanus* in habit and leaf-form; the bracts are somewhat erose on the margins as in that species, but they are scarcely at all dilated, and if so only the innermost, and they are tipped with the short and broad spines characteristic of *C. spathulatus*. To this are referred:

COLORADO: Estes Park, Aug. 16, 1905, *Osterhout 3091;* Sulphur Springs, July 16, 1905, *Osterhout 3057;* Happy Hollow, July 14, 1898 (collector not given), Herb. State Agric. College, *no. 2801.*

The last was distributed as *Carduus griseus* and has perhaps given rise to a wrong impression of that species. *C. spathulatus* was then undescribed and the bracts excluded no. 2801 from *C. americanus.* We have no specimens of either of the supposed parents, from exactly the same locality, but *C. americanus* is found nearly everywhere in the mountains of northern Colorado, and Osterhout in the original description of *C. spathulatus* states that it is common on both sides of the range of mountains east of the North Park.

CARDUUS AMERICANUS × COLORADENSIS

Carduus erosus Rydb. Bull. Torrey Club **28**: 507. 1901.

This was originally described as a distinct species. Professor Nelson reduces it to a synonym of *Carduus americanus.* The broad hemispheric head, the broad bracts with less dilated tips, and the more spiny leaves with more numerous and lanceolate lobes are very different from those of the typical *C. americanus.* The form and structure of the involucre, the form of the leaves, and the habit approach those of *C. coloradensis.* The upper surface of the leaves and the midrib beneath show some of the arachnoid hairs characteristic of *C. coloradensis* and its allies. We have no specimens of the two supposed parents from Durango, the type locality of *C. erosus,* but the locality is not without the range of either.

COLORADO: Durango, 1896, *F. Tweedy 517.*

CARDUUS ACAULESCENS × AMERICANUS

This resembles most *C. americanus,* but the stem is lower, the heads crowded, the involucral bracts elongated and less dilated

at the tip, the leaves have more lanceolate lobes and stronger spines, and the stem and midribs of the leaves are more or less arachnoid-hairy. The clustered heads, the arachnoid pubescence on the stem, and almost glabrous bracts, with broad bases gradually tapering upwards, would suggest *C. acaulescens* as the other parent.

COLORADO: Plains and foothills near Boulder, July, 1903, *Tweedy 5852*.

CARDUUS ACAULESCENS × COLORADENSIS

Carduus acaulescens (A. Gray) Rydb. and *C. coloradensis* Rydb. are closely allied and many regard them as forms of the same species. As they often grow together and intermediate forms are found, this disposition seems plausible, but these intermediate forms may as well be explained by hybridity. The typical *C. acaulescens* has practically no stem and the small campanulate heads, seldom more than 3 cm. wide, are sessile and congregated in a flat-topped head-like cluster, while the typical *C. coloradensis* has a stem 3–10 dm. high and the larger heads are more or less peduncled, 4–7 cm. broad, hemispheric, and scattered. The intermediate forms are usually low-stemmed and the heads, intermediate in size and shape, are in a dense flat-topped cluster at the end of the stem. At the south end of Fish Lake, Utah., *C. acaulescens* and *C. coloradensis* were found together by myself and Mr. Carlton and the specimens in the New York Botanical Garden bear the numbers *7547* and *7546*, respectively. The supposed hybrid also was collected, although I can not find any specimens now in the collection of the New York Botanical Garden. They may have met the same fate as some other specimens of the collection in being damaged by rain. There is one specimen, however, in our herbarium, which I regard as belonging to this hybrid, viz.

COLORADO: Sulphur Springs, Grand Co., Aug. 8, 1907, *Osterhout 3615*.

CARDUUS ACAULESCENS × SCOPULORUM

Carduus crassus Osterhout, MS.

This was distributed under the manuscript name cited above and regarded by Osterhout as a distinct species. I am inclined

to think it a hybrid of the two species mentioned for the following reasons. The form and the pubescence of the leaves are almost exactly those of *Carduus acaulescens*. The small and clustered heads also suggest that species; but the plant has an evident stem and the involucre is decidedly arachnoid-hairy. As *C. scopulorum* and *C. Parryi* are the only species in Colorado which have arachnoid involucres, one of these may be supposed to be the other parent. As *C. Parryi* has also dilated erose bracts, it must be thrown out of consideration. In *C. crassus* the involucral bracts have also the long slender spines characteristic of *C. scopulorum*.

COLORADO: Sulphur Springs, Grand Co., July 17, 1905, *Osterhout 3042*.

Neither of the two supposed parents is represented by specimens from Sulphur Springs, but there is a specimen, *Osterhout 3615*, just cited above, which I regard as a hybrid of *C. acaulescens* with another species.

CARDUUS GRISEUS×LATERIFOLIUS

Carduus canalensis Osterhout, MS.

This I included in *Carduus griseus* in my Flora of Colorado but it differs in many respects from the type of that species, the leaves being much broader and less lobed, the upper leaves with broad auricles and the inner bracts with dilated erose tips. These two characters suggest *C. laterifolius*, from which it differs in the long and broad spines of the outer bracts, characteristic of *C. erosus*.

COLORADO: Canyon of Thompson River, Larimer County, August 16, 1905, *Osterhout 3089*.

This specimen was collected together with the type number of *C. laterifolius*, viz., *Osterhout 3090* (the next number).

CARDUUS GRISEUS×SCOPULORUM

Carduus Osterhoutii Rydb. Bull. Torrey Club **32**: 131. 1905.

This has the habit, the leaf form, and the long flat spines of the bracts of *Carduus griseus*, but the inflorescence is conspicuously arachnoid-hairy as in *C. scopulorum* and the leaf segments are rather more numerous than in *C. griseus*. The following specimens belong here:

COLORADO: Red Cliff, Eagle Co., July 17, 1902, *Osterhout 2706*; Tennessee Pass, July 28, 1902, *Osterhout 2640.*

The first of these specimens was associated with *Carduus griseus*, *Osterhout 2707* (the next number), collected at the same date and locality. *C. griseus* was collected at Red Cliff in 1906 also, *Osterhout 3362.* *C. scopulorum*, the other supposed parent, is rather common throughout the mountains of Colorado.

CARDUUS GRISEUS × PARRYI

Carduus araneosus Osterhout, Bull. Torrey Club **32**: 612. 1905.

Osterhout in the original description of *Carduus araneosus* suggests the relationship with *C. Parryi.* *C. araneosus* differs from that species mainly in the less greenish corollas, the stouter and broader spines of the bracts, and the grayish under surface of the leaves. These characters suggest *C. griseus*, but the involucral bracts are decidedly arachnoid-pubescent and the inner bracts are more or less dilated above and erose. The following specimens belong here:

COLORADO: Red Cliff, Eagle Co., June 26, 1900, *Osterhout 2169*; and also Aug. 16, 1906, *Osterhout 3363;* Boreas, July 24, 1897, *Crandall 2806;* without locality, *J. Wolf 459* (Wheeler Exp.).

The first two specimens were collected at Red Cliff, where also two numbers of *C. griseus* (see under preceding hybrid) and one of *C. Parryi*, viz., *Osterhout 2708*, were collected.

CARDUUS OREOPHILUS × SCOPULORUM

This resembles *C. scopulorum* in the heads crowded at the ends of the stem, the arachnoid involucres and general habit; but the leaves are broader, with fewer lobes; the involucral bracts are broader at the base, and the flower-cluster not nodding. In these characters it approaches *C. oreophilus*, but it has less deeply dissected leaves with broader lobes, and the inflorescence is much more arachnoid.

COLORADO: Silver Plume, Aug. 23, 1895, *Shear 4948* and *4960.*

Carduus oreophilus also was collected at Silver Plume the same day by Shear, *no. 3258*, and also by Rydberg on the following day. *C. scopulorum* is common in the upper part of Clear Creek above Silver Plume. In the herbarium of the Garden there is one speci-

men from near Gray's Peak, *Shear 4734*, collected on the same date as *4948* and *4960*.

CARDUUS COLORADENSIS×UNDULATUS

With the specimen cited below, Mr. Osterhout sent a slip of paper on which is written: "Do not think this is *Carduus undulatus* — do not know what it is." It resembles *C. undulatus*, the flowers being red, although paler, the bracts having a glandular dorsal ridge, and the general habit and leaf-form being similar, but the dorsal ridge is very inconspicuous. It resembles perhaps more *C. coloradensis* in habit, in the form of the bracts, and the lanceolate twisted tips of the innermost of these. There is also an indication of arachnoid hairs on the stem, but the corollas are pink, not dirty white, and there is an evident though narrow dorsal ridge towards the ends of the bracts.

COLORADO: Wolcott, Eagle Co., July 11, 1902, *Osterhout 2653*.

Mr. Osterhout collected also *C. coloradensis* at the same date and locality, viz., *2651*.

CARDUUS FILIPENDULUS×OCHROCENTRUS

Carduus dispersus Osterhout MS.

This has the large heads and the long spines of *C. ochrocentrus* but the broad non-decurrent leaves and dark green glabrate upper surfaces of *C. filipendulus*.

COLORADO: Home, Larimer Co., July 29, 1904, *Osterhout 2898*.

Both of the supposed parents are common in Larimer County. Mr. Osterhout doubts that this can be a hybrid between the two supposed parents given above, as he has not seen either growing so far up in the mountains.

CARDUUS FLODMANII×MEGACEPHALUS

This specimen cited below was determined as *Carduus Flodmanii*, but its leaves are much broader and with shorter and broader lobes, the heads are larger, and their bracts more glutinous than in the typical *C. Flodmanii*. The plant is almost exactly intermediate between that and *C. megacephalus*.

COLORADO: Fort Collins, July 30, 1904, *Osterhout 2903*.

Both of the supposed parents are common around Fort Collins.

CARDUUS PLATTENSIS × UNDULATUS

The specimen cited below was sent me by Mr. Osterhout, who suggested that it was a hybrid of *Carduus plattensis* Rydb. and *C. undulatus* Nutt. It has the head of the former, but somewhat smaller and with narrower and less viscid bracts. The leaves also are those of that species but approach those of *C. undulatus*.

COLORADO: Thompson's River, Larimer Co., Aug. 16, 1905, *Osterhout 3087*.

There are many features that suggest hybridity in *Carduus perplexans* Rydb. In the original description, attention was directed to its relationship to *C. Centaureae* (= *C. americanus* Greene) and also to the *C. altissimus* group. At that time I was inclined to regard it as a hybrid between *C. americanus* and *C. filipendulus*, but the broad leaves seemed to contradict such a disposition.

Since that time I have been inclined to regard it as a hybrid of *C. laterifolius* Osterhout and *C. filipendulus*, as the former has broad leaves resembling those of *C. perplexans*. The bracts, erose-tipped as they are, are not much like those of *C. laterifolius*. Mr. Osterhout suggests that it might be a hybrid of an undescribed species, specimens of which he has sent me. In these the bracts resemble those of *C. perplexans* very much and the flowers are also red; but the leaves are narrow and deeply pinnatifid. This species and *C. filipendulus* could scarcely produce a hybrid like *C. perplexans*.

All the supposed hybrids given above were collected in Colorado. Besides these the following are in the herbarium of the New York Botanical Garden from neighboring states.

CARDUUS MEGACEPHALUS × OCHROCENTRUS

There seem to be two rather distinct forms included in *Carduus ochrocentrus*. As both are found in Texas and New Mexico and I have not seen the type specimen, I am uncertain which of the two is *C. ochrocentrus* proper. One of them extends northward to Nebraska and northern Colorado and is the only one found within the range of my studies. For the present I regard this as *C. ochrocentrus*, until further information can be had. It is characterized by strongly decurrent and strongly spinose, crisp leaves,

with numerous short crowded lobes and densely white-tomentose beneath. The spines of the involucral bracts are also long and strong, in age usually strongly spreading. *C. megacephalus*, which resembles it in many respects, has much broader flatter leaves, with fewer lobes and short spines, scarcely decurrent and at least the upper ones with broad clasping bases. The spines of the involucres are also short and weak. The following two specimens have leaves resembling those of *C. ochrocentrus* but not decurrent and have involucral bracts with the short weak spines of *C. megacephalus*.

NEBRASKA: Banner County, July 6, 1891, *Rydberg 215a*.

KANSAS: Plains, Ellis County, July 16, 1895, *Hitchcock 309*.

The first of these was collected with *Carduus megacephalus*, *Rydberg 215*. *C. ochrocentrus* was common in the region. *Rydberg 214*, belonging here, was collected a few miles further south. There are also forms intermediate between *C. megacephalus* and *C. undulatus*, but as these two species are so closely related that it is almost impossible to draw a line between them, I have not tried to distinguish any hybrids.

CARDUUS FOLIOSUS × SCOPULORUM

This has the habit and bracts of *Carduus foliosus*, but the involucre is densely arachnoid as in *C. scopulorum* and the leaves have more numerous and crowded lobes, in that respect approaching those of the latter species.

WYOMING: Big Horn Mountains, Aug., 1899, *Tweedy 2120*.

Carduus scopulorum was evidently growing near it, for a specimen belonging to it and collected by Tweedy bears the number *2122*. *C. foliosus* is common in the Big Horn Mountains. Among others are *Tweedy 3051*, collected there the following year.

Carduus Tweedyi, judging from the scarcity of the plant and from the fact that it combines the characters of two groups, may also be a hybrid. A plant of its type may be produced by the crossing of *C. polyphyllus* and a red-flowered species such as *C. Macounii* or *C. edulis* but neither of these two has been found east of the continental divide and *C. Tweedyi* not west of it. A somewhat similar plant would be produced by the crossing of *C. scopulorum* and *C. Eatoni*, but I have seen no specimens of the latter outside of Utah.

CARDUUS BUTLERI×KELSEYI

The leaves of the two supposed parents are very similar, so the differences are mostly found in the inflorescence and the involucral bracts. See under the description of *Carduus Butleri*.

The supposed hybrid has the inflorescence of *C. Kelseyi*, the bracts of *C. Butleri*, but slightly arachnoid-hairy.

MONTANA: Rost Lake, July 28, 1908, *Butler 703*.

Carduus Butleri was collected at the same locality and on the same date, *Butler 677;* and *C. Kelseyi* three days later a little higher up in the mountains, *Butler 398*.

CARDUUS EATONI×OLIVESCENS

Cnicus Eatoni A. Gray included several forms. Three of these had been distinguished by D. C. Eaton, who, however, had applied wrong names for two of them. The first of the three Eatonian synonyms cited by Dr. Gray is *Cirsium eriocephalum* var. *leiocephalum*. Dr. Gray's description also applies principally to this. Hence *Carduus leiocephalus* (D. C. Eaton) Heller becomes a synonym. *Cirsium foliosum* D. C. Eaton, I think, is the same as *Carduus nevadensis* Greene and *C. Drummondii* D. C. Eaton is a Nevada plant, almost identical with *C. oreophilus* of Colorado.

The supposed hybrid under consideration resembles *C. Eatoni* in general habit, but the leaves have fewer and deeper lobes and are grayish tomentose beneath, and the involucres have shorter and weaker spines. It differs from *C. olivescens* in the broader segments of the leaves, the narrower bracts, of which the outer are spinulose-ciliate as in *C. Eatoni*.

UTAH: Aquarius Plateau, Aug. 4, 1905, *Rydberg & Carlton 7422*.

Carduus olivescens also grew on the Aquarius Plateau. The type of it was collected the following day and bears the number *7450*. *C. Eatoni* is common in the same region, although Carlton and myself did not preserve any specimens from the Aquarius Plateau.

CARDUUS PULCHELLUS×UNDULATUS

This most resembles *Carduus pulchellus* in habit, but the involucres are more hemispheric instead of truly campanulate, the bracts are broader and with a narrow glutinous ridge, and the inner

ones are not so elongated as in that species. From *C. undulatus* it differs in the narrower segments of the leaves, the glabrate upper surface of the same, the somewhat purple-tipped inner bracts, and the inconspicuous dorsal ridge.

UTAH: Fish Lake, near Twin Creeks, Aug. 8, 1905, *Rydberg & Carlton 7499* and *7487;* Beaver City, 1877, *Palmer 273*.

COLORADO: Grand Junction, June 15, 1900, *Mrs. Stokes*.

Neither of the supposed parents was collected at the same date and locality, but both are found in Utah and Colorado. *C. pulchellus* was collected by Carlton and myself in the neighborhood of Marysvale, *nos. 7016* and *7179*.

A good deal can be said about the treatment of this genus in the New Manual of Botany of the Central Rocky Mountains. Many of the species, reduced to synonymy, have little or no relationship to those of which they were made synonyms.

Under *Carduus americanus* we find the following synonyms: *C. Centaureae* Rydb., *C. erosus* Rydb., and *C. griseus* Rydb. The first is a pure synonym. When the name was proposed I was following the Madison amendments of the "Rochester Code," and according to those amendments an older varietal name invalidated the name *C. americanus*. *C. erosus* I now think is a hybrid of *C. americanus* and *C. coloradensis*. *C. griseus*, on the contrary, is a good species, easily distinct from *C. americanus*, and its bracts have no dilated erose tips. In my Flora of Colorado I included in it at least two hybrids of *C. americanus* with this species and related ones. This may have given Professor Nelson a wrong idea of *C. griseus*.

Under *Carduus Hookerianus* we find as a synonym *C. Osterhoutii*. *C. Hookerianus* is, so far as I know, not found within the United States. It is from the Saskatchewan region. I, as well as others, have referred specimens from Colorado to it, but all these belong to a form of *C. scopulorum*. This may have been the reason why Nelson has made the latter a variety of *C. Hookerianus* under the name *C. Hookerianus eriocephalus*. *C. Osterhoutii* is not closely related to *C. Hookerianus*, but more so to *C. scopulorum*. I think it is a hybrid of that species and *C. griseus*.

Under *Carduus Hookerianus eriocephalus* we find the follow-

ing synonyms: "*Cnicus eriocephalus* Gray, *Carduus scopulorum* Greene l. c., *C. Tweedyi* Rydb. l. c., *C. araneosus* Osterh. * * * *C. Eatonii* Gray, * * * *C. canovirens* Rydb. l. c. (?) *C. pulcherrimus* Rydb." Of these the two first are pure synonyms. *Carduus Tweedyi* is a related red-flowered species (see page 552). *C. Eatoni*, as I understand it and limited to *C. eriocephalus* var. *leiocephalus* D. C. Eaton, is a good species, forming a group by itself. *C. araneosus* is not related to *C. scopulorum* but to *C. Parryi*, as Osterhout suggested, and is probably a hybrid of that species and *C. erosus*. *C. canovirens* and *C. pulcherrimus* do not belong even near *C. scopulorum*, but to the *C. undulatus* group. *C. canovirens* has no very close relative. The nearest is perhaps *C. canescens* (Nutt.). Nelson once thought it a good species, distributed it under a manuscript name, and would have published it, if his attention had not been called to the fact that it was already published. *C. pulcherrimus* is most closely related to *C. ochrocentrus* and stands to that species nearly in the same relationship as *C. undulatus* does to *C. megacephalus*.

Under *Carduus foliosus* are found the following synonyms: *C. scariosus* (Nutt.) Heller and *C. coloradensis* Rydb. Judging from Nuttall's original description of *Cirsium scariosum*, it is not at all related to *Carduus foliosus* Hook. See remarks above under *C. lacerus*. *Carduus coloradensis* is not to be referred to *C. foliosus*. It was based mainly on *Cnicus Drummondii* of the Synoptical Flora, and is apparently the same as *Carduus Drummondii* of the New Manual, the corolla of which is described as white. The original *Cirsium Drummondii* T. & G., of which there is a duplicate in the Torrey herbarium, has rose-purple corollas. The only specimens I have seen from the United States, are from the Black Hills of South Dakota. All the others are from British America.

Carduus oreophilus Rydb. is given as a synonym under *C. Drummondii*. From what is just stated it may be seen that it is not the original *C. Drummondii* and a comparison between my description in the Bulletin of the Torrey Botanical Club and that of *C. Drummondii* in the New Manual shows that it is not *C. Drummondii* as understood by Professor Nelson. *C. oreophilus* is very local and many things suggest a hybrid, but I have failed

to find two species that would produce a combination of characters found in *C. oreophilus*. A mixture of four species, *C. pulchellus*, *C. spathulatus*, *C. scopulorum* and *C. coloradensis* might do it. I think therefore that it is best to regard it at present as distinct.

Under *Carduus bipinnatus* (Eastw.) Heller, in the New Manual, we find: *C. pulchella*[*us*], *C. truncatus* Greene(?) and *C. spathulatus* Osterh. The only true synonym is *C. truncatus* Greene. *C. pulchellus* is related to it, but the leaves are white-tomentose beneath. *C. spathulatus* Osterhout is related to *C. griseus*, though its involucral bracts are much shorter. The plant resembles closely *C. americanus*, but the bracts are not at all fimbriate.

Carduus Tracyi Rydb. is, in the New Manual, made a synonym of *C. Nelsonii* Pammel (Pammel did not use the generic name *Carduus* and the page is wrongly cited), while the latter is kept distinct from *C. plattensis* Rydb.

A botanist with broad limitations of species might regard *Carduus plattensis*, *C. Nelsonii*, *C. Tracyi*, *C. brevifolius*, and *C. palousensis* as one species. They are all closely related but each has a definite range of its own. *C. plattensis* belongs to the sandy regions of Nebraska, Kansas, and northeastern Colorado; *C. Nelsonii*, as far as I know, is found only in Wyoming; *C. Tracyi* in southern Colorado; *C. brevifolius* in Wyoming and Montana; and *C. palousensis* in western Idaho and eastern Washington and Oregon. *Carduus Nelsonii* and *C. plattensis* are the most closely related of the four; the only difference I can find is that *C. plattensis* has the inner bracts prolonged into linear lanceolate, spreading, more or less crisp tip, a character not found in the rest. The characters given by Nelson in the key to distinguish *C. Nelsonii* and *C. plattensis* are useless, because the characters assigned to the latter are not true.

Under *Carduus filipendulus* (Engelm.) Rydb., in Coulter & Nelson's New Manual, are given as synonyms: *C. Flodmanii* Rydb. and *C. oblanceolatus* Rydb. The description of *C. filipendulus* is a verbatim copy of my description of *C. Flodmannii*. Little could be said against this, if the two were the same, but this is not the case. In the key, Professor Nelson distinguishes *C. filipendulus* from *C. undulatus*, *C. megacephalus*, and *C. ochrocentrus* by the characters: "Leaves becoming

green and glabrate on the upper side" against "Leaves permanently tomentose on both sides." The glabrate character is correct as far as *C. filipendulus* in concerned and was the reason why Dr. Gray associated it with *C. altissimus;* but it is not true of *C. Flodmanii*, for in that species the tomentum is as permanent as in *C. undulatus* and *C. ochrocentrus* and far more so than in *C. megacephalus.* In the key *C. filipendulus* is characterized, but the description is of *C. Flodmanii* under a wrong name. Dr. Gray included *C. Flodmanii* in his *Cnicus undulatus canescens.*

Professor Nelson has admitted a variety *Carduus undulatus canescens* (Nutt.) Porter. Evidently this was unknown to him for he simply copies Gray's characterization of *Cnicus undulatus canescens.* Some years ago, while visiting the Gray herbarium, I was curious to see what Gray meant by this variety. I found that it contained a mixture of *Carduus Flodmanii, C. oblanceolatus*, another related species of Arizona, and *Cirsium brevifolius* Nutt. The last is a yellow-flowered species related to *Carduus Nelsonii* and *C. plattensis*, and antedates both. Of these *C. Flodmanii* agrees best with the description of *Cirsium canescens* Nutt., and it might be that species. I have seen, however, a specimen of another species with strong erect involucral spines, which bore the name *Cirsium canescens* in Nuttall's own handwriting. Whether that specimen was the type or not I do not know, but I have adopted the name *Carduus canescens* for that species. Pammel in his treatise on the Iowa thistles adopted the name *Cnicus canescens* for *Carduus Flodmanii.* If Nelson had followed him, I would not have made any criticism, as there is some doubt as to which the name *canescens* belongs to, *C. Flodmanii* or the species for which I have adopted it.

Professor Nelson has also omitted all the Utah species described by Marcus E. Jones, although most of them belong to the range of the New Manual.

CENTAUREA and ARCTIUM

Neither of these two genera are included in the New Manual, although *C. Cyanus* has been collected at several places in Montana, *C. solstitialis* L. at Salt Lake City, Utah, and *A. minus* Schk. in Colorado.

NEW YORK BOTANICAL GARDEN.

Local flora notes—VII*

NORMAN TAYLOR

In order to hasten the completion of these notes it is planned to publish them monthly, either in Torreya or the BULLETIN. For the same reason they will hereafter be in tabulated form.

LORANTHACEAE

Species	*Specimens wanted from*
Razoumofskya pusilla (Peck) Kuntze.	Catskill region, northern N. J. and Pa.
Phoradendron flavescens (Pursh) Nutt.	Central and northern edge of pine-barrens in N. J.

ARISTOLOCHIACEAE

Asarum reflexum Bicknell.	Anywhere in the range.†

POLYGONACEAE

Rumex hastatulus Muhl.	New Jersey.
Rumex salicifolius Weinm.	Anywhere in the range.
Rumex verticillatus L.	N. Y. and Pa.
Rumex sanguineus L.	Near any city. Is it established?
Rumex pulcher L.	Near any city. Is it established?
Rumex conglomeratus Murr.	Near any city. Is it established?
Polygonum amphibium L.	Northern N. Y. and Pa.
Polygonum arifolium L.	Northern N. Y., N. J., and Pa.
Polygonum littorale Link.	S. I. and L. I., also N. J. coast.

*Continued from Torreya 10: 224–228. O 1910.

†The local flora range as prescribed by the Club's Preliminary Catalogue of 1888 is as follows: All of the state of Connecticut; Long Island; in New York the counties bordering the Hudson River up to and including Columbia and Greene, also Sullivan and Delaware counties; all of New Jersey; and Pike, Wayne, Monroe, Lackawanna, Luzerne, Northampton, Lehigh, Carbon, Bucks, Berks, Schuylkill, Montgomery, Philadelphia, Delaware, and Chester counties in Pennsylvania.

Species	*Specimens wanted from*
Polygonum dumetorum L.	Anywhere in the range.
Polygonum Hartwrightii A. Gray.	Central and southern N. J. and southeastern Pa.
Polygonum Rayi Babing.	Along any of the coasts.

CHENOPODIACEAE

Chenopodium Boscianum Moq.	N. Y. and N. J.
Salicornia Bigelovii Torr.	Coast of N. J.

AMARANTACEAE

Amaranthus pumilus Raf.	Coast of N. J.
Cladothrix lanuginosa Nutt.	Anywhere in the range.

PORTULACACEAE

Claytonia caroliniana Michx.	Northern N. J. and Pa.

CARYOPHYLLACEAE

Arenaria leptoclados Guss.	Along any of the coasts.
Arenaria groenlandica (Retz.) Spreng.	Northern N. Y., N. J., and Pa.
Arenaria Michauxii (Fenzl) Hook.	N. Y. and northern N. J.
Ammodenia peploides (L.) Rupr.	Coasts of Conn., L. I., S. I., and N. J.
Alsine borealis (Bigel.) Britton.	Northern N. J. and Pa.
Alsine pubera (Michx.) Britton.	N. J., and Pa. north of Bucks Co.
Cerastium semidecandrum L.	N. J., north of Atlantic Co.
Moenchia erecta (L.) Gaert.	Anywhere in the range.
Lychnis coronaria (L.) Desr.	L. I., Conn., and southern N. Y.
Silene virginica L.	N. Y. and Pa.
Silene alba Muhl.	N. J.
Silene antirrhina L.	N. Y., north of Westchester Co.
Silene dichotoma Ehrh.	Anywhere in the range.
Tunica Saxifraga (L.) Scop.	On L. I. or elsewhere.
Dianthus deltoides L.	Greene and Ulster Cos., N. Y., and Monroe Co., Pa.

NYMPHAEACEAE

Species	*Specimens wanted from*
Castalia tuberosa (Paine) Greene.	Anywhere in the range.
Nymphaea Kalmiana (Michx.) Sims.	Northern N. Y.
Nymphaea advena variegata (Engelm.) Fernald.	Northern N. Y., N. J., and Pa.
Nymphaea hybrida Peck.	Northern N. J. and Pa.
Nelumbo lutea (Willd.) Pers.	N. Y. and Pa.

MAGNOLIACEAE

Magnolia virginiana L.	Long Island.
Magnolia acuminata L.	Anywhere in the range.
Magnolia tripetala L.	Anywhere in the range.

ANONACEAE

Asimina triloba (L.) Durand.	N. Y. and N. J.

RANUNCULACEAE

Aconitum noveboracense A. Gray.	Orange, Greene, and Delaware Cos., N. Y.
Actaea rubra (Ait.) Willd.	N. J. and Pa.
Anemone riparia Fernald.	N. J.
Caltha radicans Forst.	Stations not in Britton's Manual.
Clematis ochroleuca Ait.	N. J.
Clematis Viorna L.	Southern Pa. and (?) N. J.
Coptis trifolia (L.) Salisb.	Below 500 ft. elevation anywhere.
Hepatica acuta (Pursh) Britton.	N. J. and Pa.
Hydrastis canadensis L.	Anywhere in the range.
Ranunculus pusillus Poir.	Pa.
Ranunculus alleghaniensis Britt.	Northern N. Y., N. J., and Pa.
Ranunculus pennsylvanicus L.	N. J. and Pa.
Batrachium trichophyllum (Chaix) F. Schultz.	Anywhere in the range.
Trollius laxus Salisb.	N. Y.
Xanthorrhiza apiifolia L'Hér.	Anywhere in the range.

Species	*Specimens wanted from*
Isopyrum biternatum (Raf.) T. & G.	Anywhere in the range.

BERBERIDACEAE

Podophyllum peltatum L.	Northern N. J.
Jeffersonia diphylla (L.) Pers.	Anywhere in the range.

PAPAVERACEAE

Sanguinaria canadensis L.	N. J., south of Middlesex and Mercer Cos.

FUMARIACEAE

Bicuculla canadensis (Goldie) Millsp.	Northern N. J. and Pa.
Capnoides flavulum (Raf.) Kuntze.	Middle counties of N. J.
Capnoides aureum (Willd.) Kuntze.	Anywhere in the range.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1910)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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Vol. 37 No. 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

DECEMBER, 1910

New species of Uredineae—VII

JOSEPH CHARLES ARTHUR

Since the publication of the last number in this series* of articles many species of rusts have come to light, which appear to be undescribed. Some of these forms are the discovery of collectors in the field, and have been sent to this laboratory for study; other forms have been brought to light in the course of the monographic study of the order in preparation for the North American Flora; and a few forms have been known for many years and have passed under collective names or been placed in the wrong genera owing to imperfect knowledge of the spore-forms. The writer is appreciative of the kindness of his many correspondents who have sent material for study, and who, in most instances, have placed no restrictions upon the use of it, a courtesy to the general cause of scientific advancement.

In the last preceding number of the series a description was published of a rust on an undetermined species of host, locally known as "Washington Vine." It was given the name *Uredo inquirenda*, with the hope that the matter would attract the attention of some one who could suggest the probable identity of the host. This hope has been realized. Mr. Elam Bartholomew writes that the common Matrimony Vine (*Lycium vulgare* Dunal) is known in some localities as "Washington Vine." From this suggestion it has been easy to verify the host of *Uredo inquirenda* as *Lycium vulgare*, and to show that the new name is a synonym of *Puccinia globosipes* Peck.

*New species of Uredineae. Bull. Torrey Club 28: 661–666. 1901; 29: 227–231. 1902; 31: 1–8. 1904; 33: 27–34. 1906; 33: 513–522. 1906; 34: 583–592. 1907.

[The BULLETIN for November, 1910 (37: 523–568. *pl. 34, 35*) was issued 30 N 1910.]

Puccinia Deschampsiae sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia epiphyllous, scattered, oblong or linear, 0.5–1 mm. long, rather tardily naked, yellowish, ruptured epidermis noticeable; urediniospores obovoid or ellipsoid, 19–21 by 26–29µ; wall pale yellow, moderately thin, about 1.5µ, finely verrucose-echinulate, pores 4, equatorial; paraphyses very numerous, clavate or clavate-capitate, 12–15 by 48–90µ, wall light yellow or nearly colorless.

III. Telia epiphyllous, scattered, oblong or linear, about 0.5 mm. long or less, tardily naked, brownish; teliospores oblong or oblong-ellipsoid, 18–23 by 32–48µ, rounded or obtuse above, rounded or somewhat narrowed below, slightly constricted at septum; wall cinnamon-brown, rather thin, 1–2µ, thicker above, 3–5µ, smooth; pedicel short.

On *Deschampsia caespitosa* (L.) Beauv., Longs Peak, Colorado, near the Longs Peak Inn, 2700 meters altitude, August 6, 1907, *F. E. Clements* (Clements, Crypt. Form. Colo. *558*). The presence of paraphyses with the urediniospores, and the four equatorial pores, are characters that make this readily distinguishable from the other numerous grass rusts of the Rocky Mountains.

Puccinia Parthenii (Speg.) comb. nov.

Uredo Parthenii Speg. An. Mus. Nac. Buenos Aires **6**: 239. 1899.

II. Uredinia amphigenous and caulicolous, or only epiphyllous, usually without causing discoloration or hypertrophy, rounded, 0.3–0.7 mm. across, soon naked, cinnamon-brown, moderately pulverulent, ruptured epidermis noticeable; urediniospores ellipsoid or globoid, sometimes triquetrous and often irregular, 19–26 by 24–32µ; wall yellowish brown, moderately thick, 2–2.5µ, strongly echinulate, pores 2, equatorial or sometimes slightly depressed below the equator, with occasionally a third pore at or near the apex.

III. Telia amphigenous, irregular and often confluent, resembling the uredinia but darker in color, soon naked, seemingly pulverulent, chocolate-brown, ruptured epidermis noticeable; teliospores ellipsoid, often irregular and elongated, 29–32 by 40–45µ, smooth, rounded or obtuse at both ends, slightly or not constricted at septum; wall dark chocolate-brown, thick, 4–6µ, thicker at apex, 6–9µ, by addition of a paler cap or umbo, pore in lower cell conspicuous, near the septum; pedicel colorless, broad but collapsible, once to twice the length of spore.

On *Parthenium Hysterophorus* L. (type host), San Andres Chalco, State of Mexico, Mex., October 8, 1898, *E. W. D. Holway 3228; P. incanum* H.B.K., Kent, Texas, May 7, 1902, *S. M. Tracy & F. S. Earle 324a; P. argentatum* A. Gray, Mazapil, State of Zacatecas, Mex. March 27, 1908; Cedros, State of Zacatecas, Mex., May 22, 1908, *F. E. Lloyd.* Only the specimens of the last two collections show teliospores. Professor Lloyd was for some time engaged in scientific and economic study of the guayule (*Parthenium argentatum*), and took considerable pains to observe the behavior of the rust. He found that the rust does not affect the newer leaves of the season, but appears chiefly on the oldest leaves at the base of the season's growth and consists mostly of uredinia. The telia, which are rarely abundant, are found in the spring on the leaves remaining over from the preceding season. Attempts by both Professor Lloyd and the writer to germinate the teliospores were in vain. The rust is propagated chiefly through the urediniospores. Whether it possesses aecia or not is uncertain.

Puccinia Glaucis sp. nov.

O. Pycnia not seen, probably obsolete.

III. Telia amphigenous, solitary or sometimes confluent in small groups, 1.5–2 mm. across, roundish, 0.5–1 mm. in diameter, soon naked, pulvinate, compact, dark brown, becoming gray by germination of the spores, ruptured epidermis inconspicuous; teliospores lanceolate-oblong, 13–16 by 43–50μ, obtuse at both ends, slightly constricted at the septum; wall smooth, golden brown, rather thin, 1–1.5μ, obtusely thickened at apex, 6–9μ; pedicel light yellow, slender, one half to once length of spore.

On *Glaux maritima* L., Halifax, Nova Scotia, August 16, 1909, *John Dearness.* A well-marked leptoform on a host which heretofore has been reported only for a heteroecious *Aecidium.* It was found in considerable abundance.

Puccinia Nabali sp. nov.

O. Pycnia not seen, probably obsolete.

III. Telia chiefly hypophyllous, gregarious, in orbicular groups on discolored spots 2–5 mm. in diameter, quite soon naked, roundish, small, 0.2–0.5 mm. across, often crowded and confluent, pulvinate, dark chocolate-brown, ruptured epidermis conspicuous; teliospores clavate or spatulate, 16–19 by 39–45μ, rounded or

truncate above, somewhat narrowed below, slightly constricted at the septum; wall chestnut-brown, considerably paler below, rather thin, 1.5–2μ, much thicker above, 7–9μ, smooth; pedicel somewhat tinted, firm, usually tapering downward, one half length of spore or shorter.

On *Nabalus racemosus* (Michx.) Hook., Seven Islands, Saguenay Co., Quebec, August 6, 1907, *C. B. Robinson 785*. A well-marked species, probably a leptoform, although the sori become uncovered slowly and the spores germinate tardily.

Uromyces Glyceriae sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous, intercostal, scattered, oval or lens-shaped, small, 0.2–0.4 mm. long, soon naked, pulverulent, brownish yellow, ruptured epidermis usually inconspicuous; urediniospores broadly ellipsoid or globoid, 16–21 by 18–26μ; wall pale golden yellow, moderately thick, 1.5–2.5μ, finely and evenly verrucose-echinulate; pores 6–8, scattered, rather distinct.

III. Telia amphigenous, intercostal, scattered, oval or lens-shaped, small, 0.2–0.4 mm. long, tardily naked, finally pulvinate, dark chestnut-brown, longitudinally ruptured epidermis usually conspicuous; teliospores irregularly obovoid or oblong-obovate, 14–19 by 21–34μ, rounded, truncate or obtuse above, usually narrowed below; wall smooth, cinnamon-brown, often paler below, rather thin, 1–1.5μ, apex much thicker, 3–7μ; pedicel slender, tinted, about length of spore.

On *Glyceria septentrionalis* Hitchc. (usually listed as *G. fluitans*), Racine, Wis., Oct. 19, 1890, *J. J. Davis;* Racine, Wis., April, 1891, *J. J. Davis* (type) (Ellis & Everh., N. Amer. Fungi *2718*); Western Union Junction, Wis., Oct. 24, 1897, *J. J. Davis;* Oregon, Ill., Sept. 11, 1889, *M. B. Waite; G. acutiflora* Torr., Newport, R. I., July, 1878, *W. G. Farlow.* This species is very similar in both gross and minute characters to *Uromyces Poae* Rabenh., for which it has been mistaken, but differs especially in having twice as many pores in the urediniospores. The true *Uromyces Poae* has been collected but once in America, so far as the writer knows, which was in Nova Scotia by Professor W. P. Fraser, on *Poa trivialis*.

I am indebted to Dr. Davis for fine fruiting specimens of the host, collected Oct. 1, 1910, from the type station near Racine, with which the identity of the host has been re-established. Dr.

Davis writes that the rust has long since disappeared from the region. The other station at Western Union Junction, now known as Corliss, has become a plowed field, and of course the rust has been annihilated.

Uromyces Spegazzinii (De-Toni) comb. nov.

Uredo Spegazzinii De-Toni, in Saccardo, Syll. Fung. **7**: 845. 1888.

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous and caulicolous, scattered, or somewhat gregarious, sometimes circinate, roundish or oval, 0.5–0.8 mm. across, soon naked, cinnamon-brown, pulverulent, ruptured epidermis conspicuous; urediniospores oval or broadly elliptical, 20–26 by 26–35μ; wall rather thick, 1.5–2.5μ, dark cinnamon-brown or chestnut-brown, finely echinulate; pores 2, equatorial and opposite.

III. Telia amphigenous, scattered, roundish or oval, 0.6–1 mm. across, soon naked, pulvinate, chocolate-brown, ruptured epidermis conspicuous; teliospores ellipsoid or obovoid, 21–24 by 29–35μ, usually rounded above and below; wall chestnut-brown, rather thick, 1.5–2μ, thicker above, 8–10μ, with a slightly paler umbo; pedicel nearly or quite colorless, rather thick, about length of spore.

On *Commelina virginica* L., Austin, Texas, Oct. 16, 1908, *F. D. Heald & F. A. Wolf 232*, with III; Fisherman's Key, Fla., May 15, 1901, *S. M. Tracy 7239; C. elegans* H.B.K. St. Croix, W. I., Jan. 7, 1896, *A. E. Ricksecker 5; C. erecta* L., Key West, Fla., March 27, 1906, *A. S. Hitchcock; C. angustifolia* Michx., Jensen, Fla., Nov. 8, 1898, *P. H. Rolfs 48;* Miami, Fla., March 25, 1903, *E. W. D. Holway*, Dec. 29, 1905, *Ernst A. Bessey 32*. Common throughout the warmer parts of North and South America on *Tradescantia* and *Commelina*, usually in the uredinial stage.

This species, like many other tropical and semitropical forms reproduces itself chiefly by means of the urediniospores, the teliospores being rarely found. A collection from Texas, made by Messrs. Heald and Wolf in 1908, enables us for the first time to prepare a description of the telial stage.

The type collection was made in Argentina by C. Spegazzini on *Commelina sulcata* and named *Uredo Commelinae*, a name that was given by Kalchbrenner two years later to a quite distinct South African species, subsequently called *Uromyces Commelinae*

Cooke. This led De-Toni to rename the South American rust. Still later names for the latter are *Uredo ochracea* Dietel, founded on a Brazilian collection, and *Uredo commelinacea* Ellis & Kelsey, founded on a West Indian collection.

There is no direct evidence to show whether the species possesses aecia or not; but as nearly all rusts on monocotyledonous hosts do have aecia so far as their life cycles are known, it is a fairly safe inference that aecia will eventually be found for this species.

Uromyces Coluteae sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, scattered, roundish, small, 0.2–0.3 mm. in diameter, soon naked, somewhat pulverulent, pale cinnamon-brown, ruptured epidermis conspicuous; urediniospores broadly ellipsoid or globoid, 18–24 by 21–27μ; wall golden brown, moderately thick, 1.5–2μ, finely and rather closely echinulate; pores 3, rarely 4, equatorial.

III. Telia hypophyllous, scattered, roundish, small, 0.2–0.3 mm. in diameter, soon naked, chestnut-brown, ruptured epidermis noticeable; teliospores broadly ellipsoid or obovoid, 15–19 by 19–23μ; wall cinnamon-brown, rather thick, 1.5–2μ, with a small hyaline papilla over the germ-pore at apex, moderately and evenly verrucose; pedicel short, hyaline, deciduous. (FIGURE 1, A.)

On *Colutea arborescens* L., Manhattan, Kansas, August, 1887, *W. A. Kellerman & W. T. Swingle 1650;* Sept. 1, 1890, *W. T. Allen 1205*. This Old World species was found on plants in the nursery and grounds of the State Agricultural College of Kansas. It has heretofore been listed under the name *Uromyces Genistae-tinctoriae*, a combination first used by Winter in Die Pilze, 1881. Winter united a number of forms under the name, because, as he says, he was not in a position to decide upon diagnostic characters. The species differs from the genuine *U. Genistae-tinctoriae*, which is common in Europe on various species of *Genista*, *Cytisus*, and *Laburnum*, by having three equatorial pores in the urediniospores instead of three to six scattered pores, and by the evenly verrucose teliospores instead of those more or less striate (see figure). Spores of intermediate character are not rare. The type collection selected for the new species is the one issued as *no. 403* in Sydow's Uredineen, collected at Meran, Austria, Sept. 13, 1890, by Dr. P. Magnus.

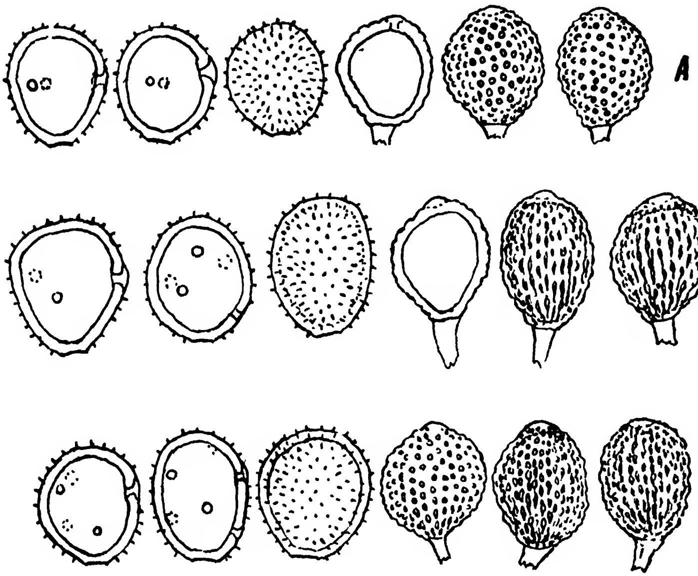

FIGURE 1. Three urediniospores on the left and three teliospores on the right in each row, partly drawn in optical section and partly in surface view: *A*, *Uromyces Coluteae* from type, Sydow, Ured. *403*; *B*, *Uromyces Genistae-tinctoriae* on *Genista tinctoria* from Rabenhorst, Fungi Eur. *1480*; *C*. *Uromyces Genistae-tinctoriae* on *Laburnum vulgare* from Kunze, Fungi Sel. Exs. *516*. ×625.

Uropyxis Agrimoniae sp. nov.

O. Pycnia unknown.

II. Uredinia hypophyllous; urediniospores broadly ellipsoid or obovoid, 13–15 by 18–21μ; wall golden yellow, rather thin, 1.5μ, evenly echinulate-verrucose, pores 8, in two zones of 4 each, equidistant from equator.

III. Telia hypophyllous, scattered, soon naked, dark chocolate-brown, pulverulent, ruptured epidermis inconspicuous; teliospores ellipsoid, 18–21 by 25–27μ, rounded at both ends, slightly constricted at septum; wall obscurely laminate, gelatinous layer rarely swelling slightly in water, chocolate-brown, rather thick, 1.5–2μ, slightly thicker at apex, 3μ, closely and evenly verrucose; pores 2 in each cell, lateral, or one of those in the upper cell in the umbo, usually indistinct; pedicel often inserted obliquely, colorless, firm, slender, terete, acuminate and roughened below, not swelling in water, 2–4 times length of spore.

On *Agrimonia mollis* (T. & G.) Britton, Sumner, Mo., Oct. 7, 1907; *E. Bartholomew 3765*. This species is an interesting addition

to the genus *Uropyxis*. The collection was made too late in the season to show characters of the sori well. The teliospores, however, were present in great abundance, but on leaves thickly covered with the bright yellow uredinia of *Pucciniastrum Agrimoniae*, among which the teliospores of the *Uropyxis* were conspicuous on account of their dark color. Owing to the slight development of the gelatinous layer, the teliospores might easily be mistaken for those of some *Puccinia*. The presence of more than one pore in each cell, however, together with correlated but less decisive characters of wall and pedicel, and especially the arrangement of the uredinial pores in zones, leaves no place for doubt that this is correctly assigned to the genus *Uropyxis*. The species should follow the second one mentioned under that genus in the North American Flora 7: 155. 1907.

Uredo Spirostachydis sp. nov.

II. Uredinia caulicolous, scattered, round or roundish, 0.4–0.8 mm. across, soon naked, usually pulvinate and only moderately pulverulent, cinnamon-brown, ruptured epidermis conspicuous; urediniospores ellipsoid or oblong, 18–21 by 23–29μ; wall dark golden brown, closely and rather coarsely echinulate, moderately thick, 2–2.5μ, pores 6–8, scattered.

On *Spirostachys occidentalis* S. Wats. (*Allenrolfea occidentalis* Kuntze), north of Yuma, Ariz., April 26, 1906, *Marcus E. Jones 7815*. The microscopic characters of the spores are in close accord with those of *Uromyces Chenopodii* (Duby) Schröt., as represented by Kunze, Fungi Selecti Exsiccati *214b*, but in the absence of teliospores it is unwise to use that name or that of any other European species. A name and description are supplied for this collection to call the attention of western mycologists to the species. It will doubtless be found also to possess aecia, appearing very early in the season in such localities as have favored the formation of telia at the close of the previous season. The succulent stems of the host are well covered with the rusty-colored sori, and the telia when discovered will probably have a similar appearance, but probably a little darker.

Uredo Beloperonis sp. nov.

II. Uredinia amphigenous and caulicolous, scattered, sometimes circinate, roundish or elongated, large, 0.5–2 mm. across,

early naked, somewhat pulvinate, pulverulent, chocolate-brown, ruptured epidermis conspicuous; urediniospores broadly ellipsoid or obovoid, 21–26 by 26–31 μ; wall cinnamon-brown, rather thick, 2–2.5 μ, hilum usually conspicuous, evenly echinulate, pores 2, opposite and equatorial, readily seen.

On *Beloperone californica* Benth., western edge of the Colorado Desert, California, April 17, 1907, *S. B. Parish 6170*, communicated by E. W. D. Holway. This acanthaceous rust is somewhat similar to *Uredo varia* Diet. of Brazil, but differs materially in all gross and microscopic characters except size and shape of spores. It is a conspicuous form.

Uredo Wilsoni sp. nov.

II. Uredinia hypophyllous, scattered, punctiform, 0.1–0.3 mm. across, soon naked, pulverulent, chestnut-brown, ruptured epidermis inconspicuous; paraphyses abundant, peripheral, terete, apparently jointed, walls smooth, colored; urediniospores globoid, or broadly obovate, 21–25 by 26–29 μ; wall light chestnut-brown, rather thick, 2–2.5 μ, strongly verrucose with colorless, conical warts, slightly separated from each other, pores 2, opposite and equatorial, not easily seen.

On *Anastrophia bahamensis* Urban, Hanna Hill, Long Cay, Bahama Islands, Dec. 7–17, 1905, *L. J. K. Brace 4029*. This rust was detected by Mr. Percy Wilson of the New York Botanical Garden, while studying the West Indian collections in the herbarium, and in recognition of this and other services rendered to the taxonomic work of the North American flora, both mycological and phanerogamic, I take the opportunity to express appreciation in the form of the name.

The powdery spores of the rust are entangled in the thick, cottony pubescence of the lower surface of the leaf, as they are discharged from the minute, subepidermal sori, and make fuscous spots in the white felted surface. Only one collection bore the rust. Other collections of the same host and also those of other species of the same genus showed very similar spots at first mistaken for it, which are made by a blackish and non-pulverulent pyrenomycetous fungus.

The spores of this rust are not especially notable, but the long, jointed paraphyses are highly distinctive and unusual. Its occurrence within the tribe Mutiseae of the composites, from which

this is probably the first rust recorded, and its endemic character on a shrub of one of the smaller West Indian islands, are items that make the study of the other stages in its life cycle, and of its relationship and distribution, matters of more than usual interest.

Peridermium fructigenum sp. nov.

O. Pycnia episquamous, numerous, inconspicuous, subcuticular, semicolumnar or irregular-conoidal, 48–58μ in diameter by about 35μ high; ostiolar filaments wanting.

I. Aecia episquamous, numerous, often crowded thickly over the whole surface of a scale, oblong, 0.3–0.5 mm. wide by 0.7–1.5 mm. long, often confluent, subepidermal, soon naked, dingy white when dry, ruptured epidermis noticeable; peridium irregularly convex, soon dropping away, peridial cells ellipsoid, loosely united, resembling the spores, but somewhat larger, rougher, and often compressed into irregular shapes; aeciospores broadly ellipsoid or obovate, rather small, 13–16 by 19–22μ; wall colorless, moderately thick, 2–2.5μ, rather finely and closely verrucose.

On *Tsuga canadensis* (L.) Carr., East Granby, Conn., June 21, 1908, *Perley Spaulding 114*. The fungus gives the cones a peculiar, whitened appearance. It is remarkable that the rust should have so long escaped the attention of collectors. The elevated pycnia and evanescent peridium readily distinguish this species from *P. Peckii* Thüm., which occurs on the leaves of the same host.

In the study of the genus *Peridermium*,* made some time ago by Mr. Kern and the writer, it was pointed out that the number of American species known, having subcuticular pycnia, was considerably less than the number of telial species known requiring similar aecia. This additional species helps to lessen the discrepancy. In accordance with the chain of reasoning there employed, the new form on *Tsuga* doubtless goes to some species of *Pucciniastrum*, and judging from known distribution, it may be the aecial form of *Puc. minimum* (Schw.) Arth., having telia on *Azalea*.

Aecidium leporinum sp. nov.

O. Pycnia not seen.

I. Aecia hypophyllous, gregarious in circular groups 1–3 mm. across, crowded, on substratum scarcely thickened and little discolored, 0.2–0.4 mm. high; peridium cylindrical, erect or somewhat

*Arthur & Kern, North American species of *Peridermium*. Bull. Torrey Club 33: 403–438. 1906.

recurved, erose, peridial cells strongly imbricated, rhomboidal below, becoming ovate-lanceolate above when seen in radial section, outer wall nearly or quite smooth, inner wall somewhat thicker, closely and prominently verrucose with slender, elongated warts; aeciospores angularly and broadly ellipsoid or nearly globoid, 18–21 by 24–29μ; wall pale yellow, rather thick, 2–2.5μ, greatly thickened above, 7–9μ, closely and finely verrucose.

On *Macrosiphonia brachysiphon* (Torr.) A. Gray, Guayamoba Canyon, Sierra Madre Mts., Chihuahua, Mex., Sept. 27, 1903, *M. E. Jones 7774*. The strongly thickened apical wall of the spores readily distinguishes this form from similar forms on the Apocynaceae, and especially from those mentioned below.

Aecidium obesum sp. nov.

O. Pycnia amphigenous, numerous, crowded in opposed groups, 0.3–1 mm. across, small, inconspicuous, punctiform, honey-yellow becoming brownish, flattened-globoid, 96–128μ broad by 58–77μ high; ostiolar filaments 30–48μ long.

I. Aecia hypophyllous, gregarious in circular groups 2–7 mm. across, crowded on scarcely thickened but much discolored spots, exserted portion evanescent; peridial cells imbricated, easily falling apart, obovate-lanceolate in radial section, inner wall finely verrucose, outer wall somewhat thicker, strongly verrucose, aeciospores globoid or somewhat ellipsoid, large, 28–35 by 32–40μ; wall colorless, greatly thickened, 5–8μ, irregular within, forming an angular or stellate cavity, closely and prominently verrucose.

On *Apocynum hypericifolium* Ait. (*A. cannabinum hypericifolium* A. Gray), Manhattan, Kanas, May 15, 1886, *W. A. Kellerman* (type), (Ellis, N. Amer. Fungi *1823;* Vestergren, Micr. Rar. Sel. *1101*); Merriam, Neb., July 11, 1899, *J. M. Bates*. This form has been confused with *Aecidium Apocyni* Schw., which occurs east of the Alleghany mountains from New Jersey to North Carolina. The eastern form has a firm peridium, and small aeciospores, 16–20μ in diameter, with thin walls, 1–1.5μ.

Through the kindness of Prof. T. J. Burrill I have been able to examine the collection recorded in Burrill's Parasitic Fungi, page 236, which was made by Mr. A. B. Seymour at Normal, Ill., June 14, 1882, and find that it consists of a single leaf of *Apocynum hypericifolium* with a single group of pycnia, but gathered too early to show even the beginning of aecia. It is impossible to decide even approximately upon the identity of the fungus.

Aecidium libertum sp. nov.

O. Pycnia not seen.

I. Aecia hypophyllous, evenly distributed over the whole surface of the leaf, substratum neither thickened nor discolored; peridium short-cylindrical, 0.3–0.4 mm. in diameter, margin somewhat recurved, lacerate, peridial cells cuboidal, squarely abutted except a downwardly imbricated outer tooth, outer wall smooth, 5–7μ, inner wall slightly thinner, 3–4μ, and closely verrucose; aeciospores angularly globoid, 17–19 by 18–23μ; wall pale yellow, thin, 1μ, closely and finely verrucose.

On *Urtica chamaedryoides* Pursh, Sapulpa, Indian Territory (now state of Oklahoma), May 1, 1895, *B. F. Bush 1269*, communicated by A. G. Johnson, who found the material in the phanerogamic herbarium of the Missouri Botanical Garden, St. Louis, Mo. This form is strikingly different from the aecia commonly found on *Urtica*, which belong to the cosmopolitan *Carex* rust, *Puccinia Caricis*, only in the distribution of the aecial sori over the host. In the structure of the aecium, and in the size, shape, and markings of the peridial cells and aeciospores, the two forms are essentially alike. Although the mycelium occupies all or most of each leaf, and most of the leaves on the plant, yet it may not be a perennial mycelium, but be diffused from an early spring infection. Most of the rusts having evenly scattered aecia, especially if the mycelium is annual, are autoecious, and there is considerable probability that in this case the associated telia will be found to follow upon the same host, and without the accompaniment of uredinia. In this connection it may be pointed out as of incidental interest that the teliospores of the leptoform, *Puccinia Urticae* Barclay, found in India, agree essentially with the teliospores of *Puccinia Caricis* (Schum.) Schröt. (*P. Urticae* Lagerh.), adding another example of the curious morphological agreement between heteroecious species with many spore-forms and autoecious species with one spore-form affecting the same host, pointed out by Dr. Tranzschel of St. Petersburg. The new *Aecidium* on *Urtica*, here described, may prove to be an extension of this same example.

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Viola palmata and its allies

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(WITH PLATE 36)

Of the 54 species, as I understand them, of North American violets east of the 100th meridian, 28 (or over one half) are of the class familiarly known as "blue stemless violets"; and of these 28 species 13 belong to a natural group represented by the widely distributed *Viola palmata* and *V. papilionacea*. The group is well characterized by having its cleistogamous flowers on short prostrate peduncles, often concealed under dead leaves or soil; as a rule the leaves are reniform in outline, the spurred petal glabrous or nearly so, the auricles of the sepals short and appressed, and the cleistogamous capsules purplish or flecked with purple.

The group is readily subdivided into species that have lobed or parted leaves, and species that do not. The cut-leaved species, of which there are six, have been greatly confused from the time when *V. palmata* was first described and figured by Plukenet in 1692 till the present. This may be, in part, because they have their fullest development in the South, where the genus has been of late less critically studied than in the North and West. But it is also quite evident that both past and present botanists have been perplexed and misled by the frequent occurrence of aberrant forms that have arisen from the crossing of *V. palmata* and *V. triloba* with each other and with allied species.

The cut-leaved species may be separated into two radically distinct subgroups represented by *Viola palmata* and *V. triloba*, and differing as follows:

A. In the *palmata* subgroup *uncut leaves are rare, if not altogether wanting;* in the *triloba* subgroup *they are frequent*, the first one or two leaves of spring and the leaves of late summer being generally uncut. In other words, the latter subgroup is strictly *heterophyllous;* the former subgroup, *homophyllous.*

B. In the *palmata* subgroup *the leaves are palmately cut;* in the *triloba* subgroup the leaves are *pedately cut.* In all cut-leaved species of *Viola* the primary cutting is ternate, as in *Trifolium.*

If the segments were not also cut, there would be no distinction into palmate and pedate; but they usually are cut, and in two widely different ways: either (*a*) both the middle and the lateral segments are again trisected or bisected, or (*b*) the middle segment remains simple, but the lateral segments are cut one or more times, the successive incisions being shorter toward the base of the leaf. The first way gives the palmate leaf; the second the pedate leaf. Abundant illustration of this will appear, as we discuss the several species of the group.

It is noteworthy in our ten species of cut-leaved stemless violets, that those pedately cut are always heterophyllous, and those palmately cut always homophyllous. There should be some explanation of this correlation, though it is not obvious. Still, as regards the six species of the *palmata* group, may we not regard it as an evidence that the two subgroups are genetically distinct—the *triloba* species all descending from an ancestor bearing pedately cut leaves at the time of greatest sexual vigor, and the *palmata* species from an ancestor bearing at all times palmately cut leaves?

There has been some scepticism as to the correctness of the commonly accepted interpretation of the Linnaean VIOLA PALMATA. His diagnosis is certainly meager and indecisive. But he cites several earlier publications, three of which are backed up by extant specimens, and one by a published figure. The latter is in Plukenet's Amaltheum, plate 447, figure 9. The flower of the figure is not that of a violet, and is wanting in the dried specimen in herb. Sloane, London. Mr. E. G. Baker reports, in the Journal of Botany for April, 1898, that the specimen is in part distinctly pubescent, and the text of Plukenet informs us that the plant was from Florida. Now, the only cut-leaved pubescent violet found in Florida is what we have been calling *Viola palmata*.

It is quite likely that some of the specimens cited by Linnaeus, collected later in Viriginia, were forms of *V. triloba*. Clayton's *793*, in Gronovius' Flora Virginica, p. 182, 1743, is described as "foliis variis, aliis integris, aliis incisis." Linnaeus's description is, "foliis palmatis, quinquelobis dentatis indivisisque." But the two Plukenet specimens of the 17th century have no strictly uncut leaves; and in the published figure one leaf has seven lobes. Mr. Baker, as above cited, says "The plant figured by Dr. Britton as

V. palmata in his Ill. Flora [2: 446] well represents the species in question, except that the leaves in the types are not so much lobed,"—i. e., have fewer lobes. The Linnaean species are often composite; but even should this prove to be the case with his *V. palmata*, we have abundant warrant for restricting the name to the extant specimens cited by him,—the species earliest described, and known to botanists since the publication of the Species Plantarum as *Viola palmata*.

I recognize three forms, or geographical races, of *V. palmata* in the eastern United States:

1. The form of the coastal plains of the south Atlantic States.—I have grown now for three seasons vigorous plants of this from central Florida, kindly sent me by Mrs. Agnes Chase. I collected it near Jacksonville, in March, 1909; and near Eutaw Springs, S. C., in March, 1907. Frequent colonies were seen for a stretch of ten or twelve miles along the old turnpike from Charleston to Columbia; but here grew also colonies of *V. triloba*, and hybrids between them. However, most plants were pure and quite like those of Florida. The leaves in March are rather deeply 5–7-lobed, the outer margin distantly serrate, the lower surface often purplish; the late summer leaves—of plants grown—were 6–10 cm. wide, the basal lobes often much dilated and coarsely toothed, the lobes between the basal and the medial long and narrow.

2. The upland form along the Alleghanies from northern Georgia to western Massachusetts.—This is rarely found near the coast in the Middle Atlantic States; but occurs near the Blue Ridge in Virginia and Pennsylvania, across northern New Jersey, on shady ledges of the lower Hudson, New York, in Connecticut especially on hills of trap, and at Great Barrington, Massachusetts. The leaf of this form is often somewhat elongate, and has more numerous and shorter incisions than the southern form. It is well figured in the Illustrated Flora.

3. The form of the Great Lakes region, from the south shore of Lake Ontario to Minnesota.—This is marked by long, narrow, and still more numerous lobes, often as many as thirteen. It is referred to by Dr. Britton in the Illustrated Flora, as a "form with the lateral leaf-lobes linear, perhaps distinct." In the Britton Manual it is put forth as "*V. Bernardi* Greene" by Mr. Pollard,

misled by Professor Greene, who had confused two things under that name. In June, 1906, having "thought out" the matter, Professor Greene named the plant *V. perpensa* (Leaflets 1: 184).

I have for three years watched these forms under cultivation, and I find no mark of specific difference in petaliferous or apetalous flowers, in pubescence, capsule, or seed. They seem to differ only in the style of lobation. In each form there is a wide range of fluctuation, the leaf assuming a different aspect, not only with change of environment, but at successsive stages of growth. The leaf-forms intergrade where the territory of one form adjoins that of another. Specimens from Syracuse, N. Y., have both styles of leaf-pattern on the same plant. I am therefore at present disposed to regard the form of the Alleghanies and that of the Great Lakes as but geographical races of the typical *V. palmata* of the south Atlantic Coast.

The species nearest akin to *Viola palmata* are *V. Stoneana** and *V. Egglestonii*,† both glabrous, both of limited range, and both well marked.

VIOLA TRILOBA was published in 1822 by Schweinitz, with some hesitancy, due chiefly to his failure to realize that he had widened the scope of Pursh's *V. asarifolia* (= *V. sororia*), so as to take into it much that properly belonged to *V. triloba*. The uncut leaves of *V. triloba* are not easily distinguished from those of *V. sororia;* and furthermore, the two plants are often cohabitant and hybridize freely. I infer that Schweinitz encountered these hybrids, for he says under *V. asarifolia*, "Not unfrequently tufts are met with of more than one foot diameter"; and also, "This species is very often found with flowers remarkably variegated, with white blotches, in an irregular way." Pied flowers and a cespitose growth are quite characteristic of hybrids. I have met with several crosses of *V. triloba* with *V. sororia* or with *V. papilionacea* in the highlands of North Carolina,‡ and with many plants that seemed the by-product of such hybrids; that is, plants with

*See Proc. Acad. Nat. Sci. Phila. 1903: 678. *pl. 35. f. 2; pl. 39. f. 3.* 1903; Bull. Torrey Club 32: 253. *pl. 16.* 1905.

†Bull. Torrey Club 37: 526. *pl. 34, 35.* 1910.

‡Schweinitz lived for many years in Salem, N. C., and while there prepared his admirable paper on *Viola* in Am. Jour. Sci. 5: 48–81. 1822.

leaves all uncut, as in *V. papilionacea*, but broadly dilated, truncate rather than cordate, with densely pubescent petioles, as in *V. triloba*. These *pseudo-sororia*'s are not uncommon in the middle Atlantic states, and are a frequent source of perplexity. Their hybrid origin is usually betrayed by their infertility.

This confusion by Schweinitz of the lines of separation between *V. sororia* and *V. triloba* was clearly shown by LeConte in his classic paper on *Viola*, published four years later. He had, I think, a correct notion of *V. triloba*, and was confident, as some moderns are not, that it differed specifically from both *V. palmata* on the one hand, and from *V. sororia* on the other. "The points of difference" he writes, "can hardly be expressed; nevertheless, I do not hesitate to pronounce it to be distinct from them all. There is something peculiar in the aspect, or if you please in the physiognomy, of each, which cannot be described, but which makes them appear distinct at first sight."*

LeConte saw fit to publish this species under a name of his own, *V. congener;* but he adds, "To this I cannot avoid referring *V. triloba* of Mr. Schweinitz; I always regret to disagree with so high an authority, but I have never been able to see between his plant and my *V. congener* any difference that was not accidental."†
If so, then the name *Viola congener* must lapse in favor of the older *V. triloba*.

It has already been stated that *V. triloba* differs from *V. palmata* in having both cut and uncut leaves, and in having the cut leaves pedate instead of palmate, the latter character appearing only when the leaf is at least 5-lobed. It will then be found that the extra lobe on either side, between the basal and the medial, is morphologically a part of the basal and not of the medial. Occasionally the sinus may be deeper between the extra lobe and the basal, than between the extra lobe and the medial; but if one

*Disterminatio vix erui potest: veruntamen distinctam esse ab omnibus discernere non haesito. Aliquid peculiare in aspectu vel si vis in physiognomonia singularum est quod non describi potest, sed primo obtutu distinctas reddit. Annals Lyceum N. Y. 2: 140. D 1826.

†Huc referre Violam trilobam cel. Schweinitz vitare non queo; semper mihi dolet cum auctoritate tam veneranda dissentire, sed nunquam differentiam aliquam inter ejus plantam, et meam V. congenerem videre potui quae non fortuita fuit. LeConte, *loc. cit.* 141.

will trace the veins of the extra lobe downward, they will be found to coalesce with the veins of the basal lobe before they together join the midvein from the medial. Mr. Witmer Stone in his paper on the violets of Philadelphia and vicinity has figured* thirteen leaves of this species, and without intention, perhaps, has displayed their pedate character.

I have collected *V. triloba* as far south as Savannah, Ga., and as far north as Orwell, Vt. Between these latitudes it occurs from the coast westward across the Appalachian Mountains, though not at high altitudes northward.

The radical difference between *Viola triloba* and *V. palmata* will appear more pronounced after we have discussed another long misunderstood type of our early botanists, the *V. palmata*, var. DILATATA of Elliott. It has appeared in recent articles and text-books as equivalent to *V. triloba;* but an attentive reading of Elliott's description ought to convince an experienced botanist to the contrary, for Elliott's plant has deeply parted leaves. He reports it as common in the uplands of Georgia and Carolina; surely it ought to be identified. After visiting this region in April for three successive years, I am satisfied that it is the same thing that Professor Greene published, in January, 1899, as *V. falcata*. (Pittonia 4: 3.)

First let us place side by side the descriptions of these two types. Some of the clauses from Elliott are rearranged to bring out the parallelism, but no word is altered or omitted; the clauses from Greene covering the same points are given in the finer type beneath.

ELLIOTT: c. *dilatata:* with leaves deeply three parted,
GREENE: blades of broad deltoid outline primarily deeply cleft or even divided into 3 segments,

the middle segment large, toothed;
of which the middle one is usually simple lanceolate or rhombic-lanceolate, } remotely toothed above the middle or even throughout.

the lateral segments 2 cleft,
the lateral divisions mostly cut into two or more lobes or subdivisions,

the exterior division dilated and toothed, sometimes dissected;
of which the outer are more or less notably lunate or falcate.

*Proc. Acad. Nat. Sci. Phila. 1903: *pl. 33*.

the whole plant very pubescent.
sparsely pubescent, the long petioles retrorsely hirsutulous.

It might be difficult to say which is more admirable, the clear conciseness of Elliott, or the detailed exactness of Greene; but surely all must concede that both these expert phytographers are describing the same thing—a pubescent violet with pedately dissected leaf. The apparent discrepancy between "very pubescent" and "sparsely pubescent" is due to the fact that Professor Greene's specimens were collected in southern Illinois, June 15, about two months after petaliferous flowering. When the plant blooms, in the South about the first of April, the unfolding leaves are markedly pubescent; two months later when they have attained their normal size the pubescence, spread out over a surface perhaps thirty times as great, seems sparse. Moreover, as with most pubescent violets, the leaves *produced* in midsummer are nearly glabrous. Such foliage is commonly described by the ambiguous word "glabrate."

Now to which of the older species has this var. *dilatata* of Elliott the closest kinship? Surely not to *Viola palmata* as he supposed; *that* has leaves palmately cut and seeds always dark brown; Elliott's plant has only some leaves cut and that pedately, and seeds always a light buff. But in these characters it agrees with *V. triloba*, as it does also in flowers, capsule, and pubescence. The only difference that I can make out is that in var. *dilatata* the cut leaves have more and deeper incisions. Moreover, in the southern Alleghanies where both forms occur, they are connected by numerous intergradations. I am therefore compelled to call the plant:

Viola triloba Schwein., var. **dilatata** (Ell.), comb. nov. *V. palmata* L., var. *dilatata* Ell.; *V. falcata* Greene.—Dry woodlands and thickets; abundant from southwestern Louisiana northward to northern Oklahoma, southern Missouri, and southern Illinois; thence eastward to northern Georgia and western North Carolina (PLATE 36).

Flowering specimens of this attractive violet are rarely seen even in university herbaria. It was distributed in Greene and Pollard's decades—no. 2, collected at Biltmore, N. C., June 3–17, 1899, long out of bloom. Other collections are: *Eggleston 4506*, Kuttawa, western Ky., June 2–18, 1909; *Bush 2313*, Fulton, Ark.,

April 13, 1905; *Bush 2942*, Swan, Mo., May 21, 1905; *Bush 4435*, Chadwick, Mo., May 14, 1907—all in fruit. Specimens in flower are: *Bush 4208*, Swan, Mo., April 21, 1907; and *Bush 4340-A*, Monteer, Mo., April 27, 1907. Specimens collected last March and April in Crowley, La. (within 45 miles of the Gulf), at Mansfield, La., at Mena, Ark., and at Westville, Okla., appear in my distribution, 1910, of violets of eastern North America.

A few words should be said of another little-known violet of Elliott's, V. ESCULENTA. It appears in Small's Flora of the Southeastern United States as *V. heterophylla* Muhl. The type is to be seen in the Elliott herbarium, now carefully preserved in the Charleston Museum. The plant has unusually long petioles and peduncles—most over 25 cm.—apparently "drawn" from the crowding of other plants. It has one uncut leaf on a petiole of 10 cm., one cordate-ovate leaf with short hastate lobes, and two broadly reniform leaves deeply 5-lobed. Raised above the leaves is a half-grown capsule split in drying, and three cm. lower, a petaliferous flower. The ticket has the following inscription:

> Viola esculenta
> mihi:
> Heterophylla
> Muhl:
> Flor. Apr:
> in udis, Ogeechee etiam in
> river swamps. Pennsyl:

When, however, in 1817 Elliott published this violet in his Botany of South Carolina and Georgia, it was under the name *V. palmata* L., var. *heterophylla*, with the remark, "From the circumstance of its being eaten by negroes, I had called it *V. esculenta;* it is however the *V. heterophylla* of Muhlenberg." A valid publication of this last specific name was made by LeConte in 1826. He observes that the plant bears hardly any affinity to *V. palmata*, and adds, "It is strange that Elliott, otherwise sufficiently disposed

to multiply species, was content to regard this as a variety.''* Doubtless both were in error in regarding Muhlenberg's northern plant as identical with the glabrous species of southern river-swamps. *V. heterophylla* stands merely as a name in Muhlenberg's catalogue of 1813; but his plant was probably *V. triloba*, a very common violet of eastern Pennsylvania. Fortunately, the *V. heterophylla* published by LeConte is invalidated by two earlier uses of the name, and effective publication of *V. esculenta* was made by Professor Greene in 1898 (Pittonia 3: 314).

Viola esculenta is very abundant in the suburbs of Jacksonville, Florida, in low woodlands on the borders of sluggish brooks, or "branches." In the older plants the rootstock has a crimson color and branches widely; the leaves, at least in cultivation, are spreading and become stiff and succulent; the flower is pale violet or white; the seeds normally light buff, though in some colonies they are a dark brown. The plant, which I have grown for two seasons and also raised from seed, strikingly illustrates the habit of the heterophyllous violets in putting forth characteristic lobed leaves only at the time of petaliferous flowering and fruiting. Not only are the late summer leaves uncut or obscurely lobed, but the seedling plants are so through the whole of the first season's growth. It is especially true of *V. esculenta* that cut leaves mark the period of the plant's greatest reproductive vigor. As LeConte says with a touch of poetry, "when flowering it takes delight in lobed leaves."† The foliage is usually quite glabrous; but in one colony I found it somewhat pubescent. I suspect this pubescence and the dark brown seeds may have come about through intimacy with a nearby colony of *V. palmata*. But in the several plants tested, I found that both these off characters, though 'dominant,' came true from seed.

*"Mirum est Elliottum alioquin satis proclivem ad multiplicandum species hanc pro varietate habere contentum fuisse."—Elliott lumped together *all* the cut-leaved stemless violets of his region under *V. palmata* and its varieties. Besides the two discussed above, *V. triloba* is covered by his description of *V. palmata*, and his var. *vulgaris*, of which he says "The two exterior lobes of the leaves have frequently a small segment near the base; grows very common in light soil," is plainly what LeConte published later as *V. septemloba*. Dr. Gray, also, aggregated these forms in the Synoptical Flora, allowing none even varietal rank.

†Cum primum e terra prodit, foliis integris, inflorescens lobatis gaudet, dein cum flores apetalos profert, folia iterum integra habet. LeConte, *loc. cit.* 139.

The seven species of the *palmata* group that have only uncut leaves call for no special discussion in the present paper, as most of them have been considered elsewhere.* But I wish to record an interesting extension of range for *Viola latiuscula*. Mr. B. H. Slavin, of the Park Department of the city of Rochester, has found the species widely distributed in western New York; it has turned up not only at several stations in the vicinity of Rochester, but in three other counties—at Portage, Falconer, and Olean, and even across the state line at Bradford, Pennsylvania.

The general conclusions of the present discussion may be presented in the following

Synopsis of Viola palmata and allied species

- Leaves all palmately 5–11-lobed or -parted, or rarely the first leaf of spring uncut.
  - Plants villous-pubescent, seeds brown. — *V. palmata.*
  - Plants nearly or quite glabrous.
    - Leaf segments closely crenate-serrate, seeds brown. — *V. Egglestonii.*
    - Leaf segments remotely crenate-serrate, seeds buff. — *V. Stoneana.*
- Earliest and latest leaves usually uncut, others pedately 3–7-lobed, -parted, or -divided, seeds generally buff.
  - Plants villous-pubescent.
    - Cut leaves mostly 3-lobed, with broadly open sinus. — *V. triloba.*
    - Cut leaves mostly 5–7-parted, with narrow sinus. — *V. triloba*, var. *dilatata.*
  - Plants obscurely pubescent and glabrate, flowers deep violet; of shady uplands. — *V. Lovelliana.*
  - Plants glabrous, flowers pale violet; of wet woods. — *V. esculenta.*
- Leaves all uncut.
  - Plants nearly or quite glabrous.
    - Flowers violet-purple, seeds brown.
      - Petioles smooth; plants of moist soil. — *V. papilionacea.*
      - Petioles glandular-roughened; plants of dry soil. — *V. latiuscula.*
    - Flowers rose-purple, seeds buff. — *V. rosacea.*
    - Flowers pale violet or white, seeds buff.
      - Vernal leaves narrow, gradually attenuate. — *V. missouriensis.*
      - Vernal leaves broad, subcordate. — *V. floridana.*
  - Plants villous-pubescent, especially on petiole and lower leaf-surface, seeds dark brown. — *V. sororia.*
  - Plants hirsutulous on upper leaf-surface, elsewhere glabrous, seeds buff. — *V. hirsutula.*

MIDDLEBURY, VERMONT.

Explanation of plate 36. All × ⅓.

A. *Viola triloba* Schwein., var. *dilatata* (Ell.) Brainerd. Mansfield, La., March 28, 1910. B. Single pedately divided leaf, from *Eggleston 4506*, Kuttawa, Ky., June 3–17, 1899. C. Ripe capsules from cleistogamous flowers, ex horto, Middlebury, Vt., transplanted from Mansfield, La., March, 1910.

*See Rhodora 9: 93–98. 1907; also Bull. Torrey Club 37: 524, 525. 1910.

VIOLA TRILOBA Schwein., var. DILATATA (Ell.) Brainerd

Notes on the distribution of some plants observed in traveling through the coastal plain from Georgia to New York in July, 1909

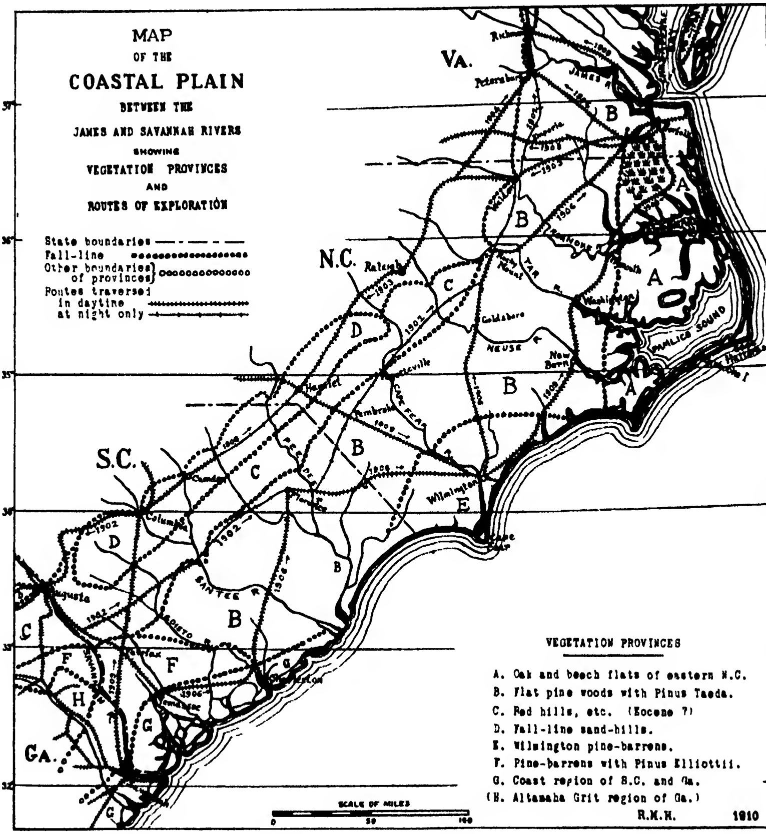
ROLAND M. HARPER

On my way northward through the coastal plain in the latter part of July, 1909, by the route described in the August number of the BULLETIN, and shown in part on the accompanying map, I noted nearly 250 species of plants, as any other traveler familiar with the flora could have done under similar circumstances. On comparing my notes afterward with statements in botanical literature relating to the regions traversed, I found, as often happens, that I had some facts not generally known, and therefore worth mentioning, about the distribution of some of the species. · Some of the simpler or less important cases have already been mentioned briefly under the several natural geographical divisions, or vegetation provinces, described in my previous paper, while those of special interest will be treated more fully here.*

In the present paper I wish to call special attention to several species of plants which, although they have been credited to Virginia by many authors, have not been seen in that state recently, if at all. None of these species whose status in the "Manual region" is now questioned were known in Clayton's time (the first half of the eighteenth century), so that his "Flora Virginica," which is believed to be based on a large amount of field work in the coastal plain of Virginia, throws no light on the subject. All but two were known to Michaux, but his "Flora Boreali-Americana" (1803) does not assign to any of them ranges extending farther north than North Carolina. All but one or two began to be credited to Virginia in the first half of the nineteenth century, and have been given a place in most floras covering the northeastern United States, up to and including the latest, that of

***In discussing the distribution of these plants I shall make frequent references to the notes of my previous trips—particularly that of 1906—through the same general region, as well as to previous literature which I have cited elsewhere.**

Robinson and Fernald (the so-called 7th edition of Gray's Manual, 1908). But none of them were found north of the Virginia-North Carolina boundary (latitude 36° 30′) by Chickering, Ward, McCarthy, Hollick, Heller, Pollard, or Kearney,* all of whom have



done considerable work in southeastern Virginia in the last quarter of the nineteenth century, and published their observations. The alleged occurrence of such plants in the "Manual region" therefore deserves careful investigation.

Dr. Gray in 1856 (Am. Jour. Sci. **72**: 205) published an interesting list of 38 plants which he said would be excluded from

*For citations of their papers see the bibliography in Kearney's Dismal Swamp report (Contr. U. S. Nat. Herb. **5**: 547–550. 1901), and the footnotes in my account of my 1906 trip

his Manual if the southern boundary of his territory, instead of following the parallel of 36° 30′ all the way to the coast, turned northward in the longitude of Washington (77° W.) to the James River, and thence eastward to the coast; which would cut out an area about 50 miles square. This list of Dr. Gray's includes a few of the species now under consideration, but naturally does not give the evidence on which they were admitted to the flora of Virginia.

In the following pages I shall have occasion to refer several times to Mr. Kearney's table of the northern limits of nearly 500 "austroriparian" (*i. e.*, coastal plain) plants, published in his report on Dismal Swamp (Contr. U. S. Nat. Herb. **5**: 450–457) in 1901, and shall not give the full citation each time. Although considerably less was known about the details of plant distribution in the southeastern states at that time than now, this was an excellent piece of work for its time, and it deserves to be extended and brought up to date.

With very few exceptions all species of plants which reach their northern limits in any of the Atlantic states from New Jersey southward (excluding of course the local species of the southern Appalachian region) seem to be confined to the coastal plain in the northernmost state in which they are found.* As a rule such species seem to have their extreme northern outposts within a few miles of the coast, except in Virginia and northeastern North Carolina, where there are more southern plants west of Dismal Swamp than east of it, as I have previously intimated.† The reason for all this is not very plain, but an understanding of it is perhaps not essential for present purposes.

SENECIO TOMENTOSUS Michx.

As in former years,‡ I saw this only within about fifty miles of Dismal Swamp, along railroads and in old fields and pastures. This time I noticed it only in North Carolina, first in Washington County, about 9 miles south of Plymouth, and last in Currituck County.

*See Shreve, Plant Life of Maryland, 69–72, 76–85, 90, 94. 1910.

†Torreya **9**: 225. 1909; Bull. Torrey Club **37**: 420. 1910.

‡See Bull. Torrey Club **34**: 367, 368. 1907; Torreya **9**: 224. 1909.

MARSHALLIA GRAMINIFOLIA (Walt.) Small.

Seen 15 times in Robeson and Bladen counties, North Carolina, between Allenton and Armour, a distance of about 40 miles. Usually in low pine-barrens, around pocosins, etc. This seems to be just about its northern limit, according to Kearney. In 1906 I saw it in a few places in South Carolina north of the Santee River, and in this southern corner of North Carolina. The only North Carolina specimens cited by Beadle and Boynton in their monograph of the genus* are from "Wilmington."

BALDWINIA UNIFLORA Nutt.

Noted only between Lumberton and Allenton, Robeson County, North Carolina. Perhaps a little later in the season it would have been more conspicuous, and recognized oftener. Nuttall in the original description gave its range as "Virginia to Florida," and most subsequent works that mention it have accepted this statement, except Chapman, who gave its northern limit as North Carolina, Gray† and Small, who exclude it even from North Carolina, and Kearney, who places its northern limit at lat. 34°, which is south of Wilmington. Croom did not find it in the vicinity of New Bern, and Wood and McCarthy in their flora of Wilmington and vicinity credit it only to Brunswick County.

PLUCHEA IMBRICATA (Kearney) Nash.

Seen three times in Effingham County, Georgia, and once about a mile north of Fairfax, South Carolina, which is probably its northern limit. It was not previously known northeast of Tattnall County, Georgia.‡

TRILISA ODORATISSIMA (Walt.) Cass.

Common nearly all the way from Wilmington to Verona, North Carolina, but not seen elsewhere northeast of Georgia. (In 1906 I did not recognize it in the Carolinas at all; but it is not as easily recognized in July as it is several weeks later.) This was credited to Virginia by Nuttall, and nearly all descriptive floras covering that part of the country since his time have followed him. But

*Biltmore Bot. Stud. 1: 4. 1901.

†Syn. Fl. N. A. 1[2]: 302. 1884. This species is mentioned, however, in all editions of Gray's Manual except the first.

‡See Ann. N. Y. Acad. Sci. 17: 142. 1906, for details of range and habitat.

Croom in his flora of New Bern and vicinity, published in 1837, stated distinctly that he had not seen it farther north than the counties of Carteret and Onslow. (It was in Onslow County that I last saw it.) And Kearney places its northern limit still farther south.

SABBATIA DECANDRA (Walt.) Harper.

In pine-barren ponds between Garnett and Scotia, Luray and Gifford, in Hampton County, South Carolina. Walter's original specimens presumably came from South Carolina, but no 19th century botanist seems to have seen it northeast of the Canoochee River.* Nearly all the existing herbarium specimens are from Florida.

POLYCODIUM CAESIUM Greene, Pittonia **3**: 325. 1898.

On the fall-line sand-hills of Orangeburg, Lexington, and Richland counties, South Carolina.

OXYDENDRON ARBOREUM (L.) DC.

On this trip seen first near Verona, North Carolina (very common between there and New Bern), and last about three miles east of Williamsburg, Virginia. Three years before, I saw it only between Tarboro, N. C., and Windsor, Va., a still smaller range.

DAUCUS CAROTA L.

Noticed first at Elizabeth City, North Carolina, and then nearly everywhere north of there. The "carrot weed" reported from Wayne, Greene, Craven, Martin, and Chowan counties in Kerr's report on the cotton production of North Carolina (Tenth Census, vol. 6, 1884) may be the same thing. In Georgia it is common enough in some parts of the Piedmont region, but I do not remember seeing it in the coastal plain. Some interesting notes on the distribution of this European weed in the eastern United States were published several years ago by L. H. Dewey.†

OXYPOLIS FILIFORMIS (Walt.) Britton.

Common in shallow ponds in Hampton County, South Carolina, and in moist pine-barrens in the eastern part of Bladen County, North Carolina. This species has long been credited to Virginia, apparently on no other evidence than a very poor speci-

*See Ann. N. Y. Acad. Sci. **17**: 177. 1906.

†Yearbook U. S. Dept. Agric. **1896**: 280, 282. 1897.

men from Harper's Ferry (which is not only among the mountains, but about 300 miles farther north than any living botanist has seen this characteristic pine-barren plant); but I have recently shown* that the mountain plant belongs to a different genus.

Croom did not find *O. filiformis* in the vicinity of New Bern, Kearney does not mention it at all in his Dismal Swamp report, and all the specimens cited in Coulter & Rose's latest monograph† are from Florida and Mississippi. In 1906 I did not see it north of Williamsburg County, South Carolina.

NYSSA UNIFLORA Wang.

Last seen in Virginia, in swamps of the Chickahominy River about 18 miles east of Richmond, between the stations of Providence Forge and Elko, with *Taxodium distichum* as usual. I have found no record of any other station for it north of the James River.

RHEXIA ALIFANUS Walt. (See Bull. Torrey Club **33**: 238. 1906.)

Common in moist pine-barrens; last seen in Washington County, North Carolina, about 13 miles south of Plymouth. Kearney puts its northern limit at lat. 35°, about 50 miles farther south.

GORDONIA LASIANTHUS L.

First seen (after leaving Georgia) about ten miles W.N.W. of Wilmington, and last about five miles S.S.E. of Washington, in Beaufort County, North Carolina. Three years before, I identified it with certainty only in Duplin County, in the same state.‡ This handsome tree seems to have been credited to Virginia first by Pursh and later by nearly every subsequent monographer, but this is probably a mistake. Kearney places its northern limit at latitude 34°, and it does not seem to be mentioned in any of the other papers on the Dismal Swamp region cited in his report.

CYRILLA RACEMIFLORA L.

Seen only in North Carolina (as in 1906), first near Hamlet, and last about 9 miles south of Plymouth. My 1906 notes placed it within still smaller limits.§

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*Torreya **10**: 237–239. N 1910.

†Contr. U. S. Nat. Herb. **7**: 193. 1900.

‡See Bull. Torrey Club **34**: 369. 1907.

§See Bull. Torrey Club **34**: 370. 1907.

EUPHORBIA ERIOGONOIDES Small.

In 1906 I found this in sand along a railroad near Florence, South Carolina,* and three years later, almost to the hour, I found it in similar situations about 50 miles due north, near Hamlet, North Carolina, which is another state for it.

STILLINGIA AQUATICA Chapm.

In a pine-barren pond just north of Luray, Hampton County, South Carolina. Although this was credited to South Carolina (exact locality not specified) by its author, I have never seen it mentioned in local floras of that state (there have been very few published, though, since this species was described, half a century ago), or even seen a specimen from there. This is therefore probably the first definite record for it in South Carolina, as well as its northernmost known station. As in the case of *Pluchea imbricata* and *Sabbatia decandra*, I had not previously seen it northeast of Tattnall County, Georgia.

POLYGALA CYMOSA Walt.

Common in ponds in Hampton County, South Carolina, and seen twice in Bladen County, North Carolina, somewhat like *Oxypolis filiformis* (see above). I did not see it north of Wilmington in previous years, and Kearney did not find it in the Dismal Swamp region. There must be a considerable gap in its range between North Carolina and Delaware, somewhat like that between the *Oxypolis filiformis* and its variety *Canbyi*.

POLYGALA LUTEA L.

As in 1906, I found no trace of this in South Carolina. I noticed it first near Hamlet, and commonest between Wilmington and Verona, and New Bern and Mackey's Ferry.

AMORPHA HERBACEA Walt.

Both in 1906 and 1909 I saw this only in dry pine-barrens in the Cape Fear region. It grows in Georgia, but is probably rare in South Carolina.

CYTISUS SCOPARIUS (L.) Link.

I saw this several times on the railroad right-of-way on the Yorktown peninsula of Virginia, but as I did not then realize what it was (never having seen it before), I could not very well

*See Bull. Torrey Club 34: 370. 1907.

note the exact localities. Mr. E. W. Berry tells me that he has found it abundant around Yorktown, where there is a tradition that it was introduced at the time of the Revolution by Cornwallis's soldiers. Dr. M. A. Chrysler* reports it as abundant near Annapolis, Maryland.

The last two editions of Gray's Manual credit this species to Virginia "and southward"; but it is not mentioned in Small's Flora of the Southeastern U. S., or even in Kearney's Dismal Swamp report.

SARRACENIA FLAVA L.

Seen about 75 times between Hamlet and Plymouth, North Carolina, and nowhere else on this trip (somewhat like *Cyrilla* and *Polygala lutea*). Kearney found it only near New Bern (and placed its northern limit at latitude 35°); and it must be very rare north of the Roanoke River, like *Cyrilla* and several other species which have been seen only a few times in Virginia.

NYMPHAEA SAGITTIFOLIA Walt.

Common in four coffee-colored (not muddy) creeks or small rivers within twenty miles of each other, between Laurinburg and Lumberton, North Carolina. (I had seen it at the first three of these places while walking from Pembroke to Laurinburg in November, 1905.)† On Sept. 22, 1794, Michaux found what is probably the same species near Fayetteville,‡ as C. L. Boynton did over 100 years later.§ Elliott knew it only from the Peedee River, which may perhaps be the type-locality. Wood & McCarthy found it near Wilmington. In 1906 I saw it only in ditches in the northern corner of Horry County, South Carolina. All these localities are within 100 miles of each other.

I have seen what passes for the same thing in several creeks and rivers at sea-level in Santa Rosa County, Florida, but never in Georgia or Alabama. If the material from Indiana and Illinois which has been referred to this species is correctly identified it has a very peculiar distribution.

*Plant Life of Maryland, 191, 445. 1910.
†See Torreya 6: 43. 1906.
‡Journal of André Michaux, edited by C. S. Sargent.
§See Biltmore Bot. Stud. 1: 148. 1902.

NYMPHAEA ADVENA Ait.

First seen in Swift Creek in the northern part of Craven County, North Carolina, which is perhaps as far south as it extends in the coastal plain. In 1906 I saw it only in ditches in the southeastern end of Halifax County, in the same state.

NELUMBO LUTEA (Willd.) Pers.

Grows in Aquia Creek and other estuaries of the Potomac River in Stafford and Prince William counties, Virginia. This is just about where Professor Ward saw it in 1885.*

PHORADENDRON FLAVESCENS (Pursh) Nutt.

Last seen near Northwest, Norfolk County, Virginia, on *Acer rubrum*. (Farther south it is oftener on *Nyssa biflora*.) In 1906 I saw it a little farther north, on the Blackwater River near Zuni.

ERIOGONUM TOMENTOSUM Michx.

Common on the fall-line sand-hills of South Carolina. Last seen in Kershaw County about 8 miles northeast of Camden.

PLANERA AQUATICA (Walt.) Gmel.

Seen this time only in the Savannah River bottoms, in Hampton County, South Carolina.

QUERCUS PALUSTRIS DuRoi.

First noticed in Caroline County, Virginia, a little south of Milford. This is the farthest south I have ever seen it.

QUERCUS PRINUS L.

Seen three times in the pine-barrens between Tom's River and Ocean Gate, New Jersey, where it had doubtless been observed by many other botanists before. I mention this here because very few other coastal plain stations for it are known. Long Island is in a certain sense nearly all coastal plain, but on that interesting island I have seen this oak only in the hilly northern or glaciated portions.† Dr. Shreve in his recent Plant Life of Maryland has reported it from a few counties in the upper part of the coastal plain of that state, and Mr. E. W. Berry tells me that he is sure he has seen it in the coastal plain of Virginia, but does not remember the exact locality. Pinchot & Ashe excluded

*Bot. Gaz. 11: 35. 1886.

†See Torreya 8: 156. 1908. Mr. E. P. Bicknell has since informed me that he knows of a station for it near Woodmere, in the flat part of the island.

it from the coastal plain in North Carolina, and Elliott likewise in South Carolina. In Georgia I have not seen it within twenty miles of the fall-line,* and Dr. Mohr could have said the same thing about its occurrence in his state, judging from the map which forms the frontispiece of his well-known Plant Life of Alabama. But in the fall of 1908 I found it in ravines near Havana, Hale County, Alabama (in the Cretaceous region of the coastal plain), and Dr. Hilgard found it over half a century ago on high rocky ridges in Tippah County, Mississippi,† which is likewise in the Cretaceous region.

MYRICA CERIFERA L.

Last seen near Providence Forge, New Kent County, Virginia, about 25 miles east of Richmond. In 1906 I last saw it about 45 miles, and in 1908 about 10 miles,‡ from the fall-line, in the same state.

MYRICA PUMILA (Michx.) Small.

Common in dry pine-barrens between Wilmington and Verona, North Carolina, and seen once in Washington County, about 12 miles south of Plymouth.

NOLINA GEORGIANA Michx.

Occasional on the fall-line sand-hills of South Carolina; seen once in the upper edge of Orangeburg County and twice in Kershaw County. Elliott knew it only from "the driest sand hills, between Orangeburgh and Columbia."

LILIUM CATESBAEI Walt.

Last seen near a pocosin between Kellum and Deppe, Onslow County, North Carolina (and in 1906 just about the same distance north of Wilmington, both stations being in the *Pinus Taeda* region). Kearney places its northern limit about one degree farther south.

ZYGADENUS GLABERRIMUS Michx.

Last seen in Beaufort County, North Carolina, five or six miles south of Washington. In 1906 I did not see it north of Burgaw, Pender County, but Kearney places its northern limit

*See Southern Woodlands 2: 96, 97. 1908.

†Geology and Agriculture of Mississippi, 266. 1860.

‡See Torreya 9: 225. 1909.

still farther north (36°), and Pursh and several subsequent authors have assigned it a place in the flora of the northern United States.

ORONTIUM AQUATICUM L.

Seen just east of Hamlet and Laurinburg, North Carolina, and Tom's River, New Jersey. At the first- and last-named localities it was accompanied by *Chamaecyparis*.

RYNCHOSPORA INEXPANSA (Michx.) Vahl.

Common along the railroad between New Bern and Norfolk, often with *Senecio tomentosus* and equally weed-like. In 1906 I saw it in similar places in Gates County, North Carolina, and in 1908 at various places between Norfolk and Emporia, Virginia. This species has perhaps never been openly charged with "weediness" before, though I have known for years that it is usually a weed in Georgia. More information about its natural habitats (if it has any) would be welcome.

RYNCHOSPORA ALBA (L.) Vahl (or its var. *macra* Clarke?).

Very few stations for this in the South are known, so it may be worth mentioning that I found it in a sand-hill bog near Hamlet, N. C.

DICHROMENA LATIFOLIA Baldw.

Last seen at about the same place as *Lilium Catesbaei* (see above), which corresponds pretty closely with the northern limit assigned to it by Kearney. It was doubtfully reported from Virginia in the fifth edition of Gray's Manual, 1867, and has been generally regarded as a member of the northern flora ever since. More evidence on this point is desirable.

CAMPULOSUS AROMATICUS (Walt.) Trin.

Noted twice in Chatham County, Georgia, once near Hamlet, and once between Elkton and Rosindale, North Carolina. I saw it oftener in 1906, from about Chadbourn to Burgaw, in the last-named state, but not in South Carolina on either trip. It has been credited to Virginia by Pursh and many of his successors, but Kearney found it only near New Bern.

ARISTIDA STRICTA Michx.

After leaving Georgia I saw this very characteristic grass of dry pine-barrens (from which the "wire-grass country" of Georgia, Alabama, etc., takes its name) only between Hamlet and Ply-

mouth, North Carolina, like *Sarracenia flava* and several other plants. In 1906, too, I saw it only in the same state between Lake Waccamaw and the Neuse River.

Pursh reported this species from "shady rocky situations, on river sides: Virginia, Carolina, etc.," and on the strength of this reference it has found a place in most northern manuals, until Prof. A. S. Hitchcock, in elaborating the grasses for Robinson & Fernald's Manual, 1908, excluded it. Mr. Kearney found it only near New Bern, like the preceding.

It is possible however that this species has been misinterpreted, and that our familiar wire-grass is not Michaux's *Aristida stricta* at all. There are some serious discrepancies between the original description and the plant that now goes by that name, and the habitat assigned to it by Pursh is decidedly not that of the wire-grass. This is a matter that deserves investigation.

CHAMAECYPARIS THYOIDES (L.) BSP.

In 1906 I did not see this at all between Alabama and New York,* but last year I was more fortunate, having noted it once among the fall-line sand-hills of Kershaw County, South Carolina, (about 10 miles northeast of Camden), twice within five miles of Hamlet,† once in Beaufort County south of Washington, North Carolina, and several times in the pine-barrens of New Jersey.

TAXODIUM IMBRICARIUM (Nutt.) Harper (*T. adscendens* Brong.).

Last seen about nine miles south of Plymouth, N. C., like several other species already mentioned. The only place where I saw this in the fall-line sand-hill region was in the same bog with the *Chamaecyparis* just mentioned, which happens to be within a few miles of where Croom once found it.‡

TAXODIUM DISTICHUM (L.) Richard.

Last seen at the same place as *Nyssa uniflora*, along the Chickahominy River in Virginia. Its inland limit in the Middle Atlantic states seems to be very similar to that of *Myrica cerifera*.

PINUS VIRGINIANA Mill.

First seen in Warwick County, Virginia, about 6½ miles north-

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*See Bull. Torrey Club 34: 377. 1907.

†See Torreya 6: 43. 1906.

‡See Am. Jour. Sci. 28: 166. 1835.

west of Newport News. Frequent the rest of the way through Virginia and Maryland, and in the Cretaceous region of New Jersey.

PINUS GLABRA Walt.

Observed only in the Savannah River bottoms near Garnett, South Carolina; the first time I had seen it northeast of Georgia. Very few South Carolina stations for it are known to botanists now living. It is interesting to note that Michaux saw what is probably this species in the vicinity of Parker's Ferry on the Edisto on April 21, 1787, though it is not mentioned in his Flora Boreali-Americana.

PINUS SEROTINA Michx.

Common enough nearly everywhere south of Dismal Swamp, but seen only once in Virginia this time, that about two miles south of Fentress, Norfolk County.

PINUS TAEDA L.

Common in all the regions passed through, to a point in Caroline County, Virginia, about 69 miles south of Washington, D. C. (Prof. Ward, in traveling southward over approximately the same route 24 years earlier, first saw it a little farther north, and published some interesting notes on it the following year.*) It has been reported from the District of Columbia and even from West Virginia,† but it does not seem possible that it could be indigenous in those places, especially the last, for if it was, its inland limit would trend northwestward,‡ instead of northeastward like many other species in this latitude.

PINUS ELLIOTTII Engelm.

Last seen about three miles north of Sycamore, Barnwell County, South Carolina. There can be little doubt that this is its northern limit, or essentially so, for there is no tree whose range, in proportion to the area covered by it, is easier to map.§

COLLEGE POINT, NEW YORK.

*Bot. Gaz. 11: 33. 34. 1886.

†See Millspaugh, W. Va. Exp. Sta. Bull. 24 (Fl. W. Va.) 475. 1892; Sudworth, U. S. Dept. Agr. Div. Forestry Bull. 17: 17. 1898.

‡See the map of its range in Mohr's "Timber pines of the Southern United States."

§I have seen it in nearly every county in which it grows, from South Carolina to Florida and Mississippi.

The genus Usnea and its Linnaean nomenclature

R. Heber Howe, Jr.

When I published my paper on the North American Usneas (Bull. Torrey Club 37: 1–18. 1910) the International Botanical Congress had not accepted Linnaeus' Species Plantarum of 1753 as a starting point for lichenological nomenclature. This adoption having been settled upon in May of the present year, it seems well worth while to fix the disposition of Linnaean names in this genus, in fact as soon as possible in all genera.

With the adoption of Species Plantarum is opened perhaps the necessity of referring to the Linnaean herbarium for type material, a matter needing a word of explanation. In 1886 Wainio (Meddel. Soc. Fauna et Flora Fenn. 14: 1–10) published an account of the material found in the Linnaean herbarium,* showing that a large number of the lichen species were either not represented at all (45 out of 80) or were compositely shown by several species. It seems quite clear that although Linnaeus referred almost always (13 exceptions) to the figures and descriptions of Dillenius, yet in Linnaeus' own collection the species were poorly represented and authentic material rare. Crombie has given us a careful report on the Dillenian herbarium, in which he found a much greater percentage of species, properly represented and figured in the author's Historia Muscorum, than Wainio did in Linnaeus' collections and work. We must therefore not put too much weight on the supposed Linnaean "types," of which Linnaeus himself makes no definite mention,† but must take Linnaeus' original descriptions for what they are worth, and supplement them with

*To most of the specimens specific names had been ascribed by Linnaeus himself. The numbers of the same specimens, either alone or placed before the names, which were likewise written by Linnaeus himself, refer to his Species Plantarum (1753) and the numbers enclosed in parenthesis to Flora Sueccia. But to many specimens names were ascribed by authorities after Linnaeus' time, such as Smith, Dickson, Swartz. [Translation of a part of Wainio's preface.]

†"It has happened that I have come into possession of no slight collection." [Translation from preface of Tomus I.]

the Dillenian figures to which he refers, and the Dillenian specimens on which the figures were based. It seems to me clear that as Linnaeus made no definite mention of "types" the specimens preserved in his collection cannot constitute such in the strict sense of the word, but simply may be used when possible as confirmative evidence.

Linnaeus appears to have largely given the binomial nomenclature to the results of Dillenius' labor, though to Dillenius in his preface he gives faint praise.

No. 71, *Lichen plicatus*, being the first species of Linnaeus, now included in the genus (p. 1154) becomes, according to some botanists,* the "type" of the genus *Usnea* (Dill.) Adans. No number 71 was found by Wainio, but he states that no. 457 of Flora Lapponica, cited by Linnaeus in the Species Plantarum = "*Alectoria ochroleuca* (Ehrh.) Nyl. (= *rigida* Th. Fr., Lich. Scand. p. 19)—Ad hanc plantam igitur *Lichen plicatus* L., Spec. Plant. (1753) p. 1154 n. 71, spectat." Now in the Species Plantarum Linnaeus cites first no. 984 of the Flora Suecica and diagnoses it as follows: "filamentosus pendulus, ramis implexis, scutellis radiatis." These last words leave no doubt as to the plant described being an *Usnea* and not an *Alectoria*. Secondly, he cites no. 457 of the Flora Lapponica, an *Alectoria*, as above proven, and there is nothing in the description to imply otherwise. Thirdly, he cites Dillenius and his figure, which, as I have already pointed out (*loc. cit.*), is according to Crombie *Usnea ceratina* Ach. (Lich. Univ. 619. 1810)—the name of Acharius becoming a synonym of *plicata* as also noted. His fourth reference is to Bauhin, whose description is too indefinite for consideration.

From the above it would seem that with no definite "type" specimen in existence, with an absolutely diagnostic description standing first on the page, and with also a reference to a recognizable figure, based on an existing specimen, the species *Lichen plicatus* would properly remain an *Usnea*. The coarsest of the pendulous Usneas, later renamed *ceratina* by Acharius, must therefore stand today as *Usnea plicata* (L.) Web. The "type" locality is "Europae & Americae borealis." The fact that one of the refer-

*A code of botanical nomenclature. Bull. Torrey Club 31: 249–261. 1904.

ences, the second, refers to an *Alectoria*, does not invalidate the name or embarrass the situation.

No. 72, *Lichen barbatus*, was found by Wainio to be represented in the Linnaean herbarium by a specimen referable to "*Usnea articulata* Hoffm." Hoffmann, however, himself referred* to Dillenius' figure (*pl. 11. f. 4*), which is of typical *articulata* as we now understand the species, and the one referred to by Linnaeus under the latter's *articulatus;* whereas Hoffmann under his own *barbata* referred to Dillenius' figure (*pl. 12. f. 6*), again following Linnaeus. There seems no doubt that Linnaeus' original description of the 1753 edition, copied from his Flora Suecica, no. 985,† did not refer to his no. 79, *Lichen articulatus*, of the 1753 work, and that we must turn to his Dillenian reference (the third) and leave it to the only plate cited to settle the question. This plate we have already found, was, according to Crombie, of an existing specimen referable to "*Usnea dasy[o]poga* (Ach.)" for which the name *barbata* must stand. The "type" locality given is also very significant. It has been my opinion that *Lichen barbatus* (= *Usnea barbata d. dasypoga* Fr.) represents a subspecific rather than a specific distinction, and I therefore proposed the combination *Usnea plicata barbata* (L.) R. H. Howe, Jr. No doubt some will prefer to claim for it specific rank, and for many nomenclatural reasons this would be the best elucidation.

No. 77, *Lichen hirtus*, Wainio tells us, has a composite representation in the Linnaean herbarium. He writes "77. *Lichen hirtus* (984) = *Usnea barbata* var. *glabrescens* Nyl. in Wainio, Lich. Vib. p. 46 (versus v. *dasypogam* Ach. vergens).—*L. hirtus* = 2 specim. *Usneae barbatae* var. *dasypogae* Ach.—77. = *Usn. barbata* var. *dasypoga* (Ach.) lusus." This would seem to argue that *Lichen hirtus* had better be considered a synonym of *Usnea barbata* rather than of *Usnea florida* as I heretofore referred it. There is little doubt, however, that Linnaeus' diagnostic word "erectus," and the Dillenian figures referred to, place *Lichen hirtus* as a synonym of *Usnea florida* (or vice versa), a name after all given only to the varying sterile conditions of the latter plant.

*Deutschlands Flora 2: 133. 1795.

†*Patentissimis* of the Flora Suecica reads *patentibus* in Species Plantarum, 1753.

Whether the page priority of *hirtus* makes *floridus* rather a synonym of the former, reduces itself largely to the question of considering composite, uncited "types" of a pendulous character of greater value than the diagnoses and plate references. The page priority of *hirtus* over *floridus*, can, however, be waived on good grounds—first, perhaps, because of its composite representation already noted; secondly, because page priority was not accepted by the Brussels Congress; thirdly, because good sense allows and advises the holding (nomina conservanda) to names of long standing, this principle being eminently applicable here. In point of fact, among lichens no better case exists. Acharius in Lichenographiae Suecicae Prodromus of 1798 (224–5) combined them under *florida*. He writes:

"Hujus tantum varietas exscutellata est: *Lichen hirtus* Linn.," an absolutely true statement, and followed by an interesting explanation given below, the truth of which can be proved only by a long study of growing plants. The sterile plants, however, I believe rarely mature as described, their substrata and environs generally preventing a luxuriant development. "*L. hirtus* Linn. & Auctor. a *L. florido* in eo tantum differt, quod ille junior pallidior, glomerulis frequenter adspersus, magis ramosus, longius fibrillosus atque sterilis; hic autem per aetatem fere nigricans, crassior, rigidior minusque ramosus sit, & scutellis amplis radiosis instruatur."

No. 79, *Lichen articulatus*, Wainio did not find represented in the Linnaean herbarium, except as heretofore referred to under *Lichen barbatus*. As, however, Linnaeus' 1753 diagnosis is characteristic, and the plate reference and the Dillenian plant are well known, there seems no reason to disturb our present position in the absence of a Linnaean "type" specimen, particularly as a comparison of the given "type" localities is also a most convincing argument.

No. 80, *Lichen floridus*, is represented in the Linnaean herbarium, as would be expected, by a specimen of the sort known to Tuckerman as "*Usnea barbata* a. *florida* Fr. This case is clear and needs no further comment, except to recognize the present position of *Usnea florida* (L.) Web. as a species, and to hold to the advantage of nomina conservanda.

We therefore have the Linnaean nomenclature of *Usnea* as follows:

Genus: Usnea (Dill.) Adans.

Type species (if we recognize such): Usnea plicata (L.) Web.

Species: Usnea plicata (L.) Web.

Usnea barbata (L.) Web. or Usnea plicata barbata (L.) R. H. Howe, Jr.

Usnea articulata (L.) Hoffm.

Usnea florida (L.) Web.

Syn. *Lichen hirtus* L.

Thoreau Museum,
Concord, Mass.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1910)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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